IMMEDIATE EFFECTS OF RAPID WEIGHT LOSS UPON SELECTED PHYSIOLOGICAL AND MOTOR RESPONSES OF COLLEGE WRESTLERS

By

WILLIAM ABBAS

Bachelor of Science

Iowa State University

Ames, Iowa

1964

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 1965

IMMEDIATE EFFECTS OF RAPID WEIGHT LOSS
UPON SELECTED PHYSIOLOGICAL AND
MOTOR RESPONSES OF COLLEGE WRESTLERS

Thesis Approved:

Aix B. Harrison
Thesis Adviser

Albin P. Warner

J H Boggs
Dean of the Graduate School

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Dr. A. B. Harrison for his patient assistance and guidance throughout the writing of this thesis.

Acknowledgements and appreciation are extended to William Harlow, Robert Douglas and Yojiro Uetake for their willful assistance as subjects for this experiment. A very special thanks to my wife, Marian, who assisted in construction and typing of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

Statement of the Problem

The continued growth of wrestling on the interscholastic and intercollegiate level brings to the attention of many coaches, administrators, parents, and participants the problem of making weight for competition. Wrestling has progressed from the college ranks in 1930's down through the Y.M.C.A., high school and to the elementary level in 1965. The growth of wrestling is partially due to the lack of a universal requirement of body build, size or strength to be eligible. Wrestling along with a few other sports has the unique factor of weight classes where participants might achieve greater success at a weight which is below their normal weight. Weight control and loss have been practiced by boxers and jockeys with no apparent harmful effect.

Many years ago Gullichsen and Soisalon[1] found that the normal physiological energy cost of wrestling is twelve times the resting rates of the performer. With this fact in mind, the slowing of normal weight gains or even small weight losses might reasonably be expected from participants in the sport.

---

[1]Gullichsen, R. and Soisalon - Soininen, J.G. "Uber die Kohlenstoffabgabe des Menshen beim Fechten und Ringer," Skandinav. Arch. F. Physiology (1921), 41:188.

The objectives of wrestling coaches should include the conditioning of his athletes to prevent injuries and to attain the maximal wrestling performance. An understanding of weight reduction and performance evaluation is an outstanding characteristic of a coach who determines the weight level that an individual might wrestle. Basic understanding of this problem will eliminate any possible weight reduction by a performer that might be harmful. Many coaches, however, still lack the necessary knowledge to make wise decisions in this matter. Many wrestlers without encouragement from their coach voluntarily lose weight to wrestle smaller men either in competition or just to make the team.

Weight loss for wrestling has long been criticized for its possible detrimental effects on health and physical fitness of the participants. Kenney[2] was one of the first to state a critical opinion. He said, "The necessity of making weight has been a serious handicap to wrestling since the sport made its debut as an intercollegiate activity." Many groups of people along with Kenney have suggested that weight reduction is little more than a subterfuge whereby one wrestler gains advantage over a smaller opponent. During the last twenty years research in this area has

---

[2]Kenney, H.E., "Problem of Weight Making for Wrestling Meets," Journal of Health and Physical Education and Recreation (March 1940), p. 25.

established some knowledge on the effects of weight reduction.

Further research, however, is needed to fully establish the immediate effects of weight loss on wrestling performance and health. This study was an attempt to determine some of the immediate effects of rapid weight reduction on the physiological and motor responses of skilled and conditioned wrestlers.

Purpose of Study

The purpose of this study was to evaluate the immediate effects of rapid weight loss upon selected physiological and motor responses of college wrestlers.

Definition of Terms

Dehydration --- The excretion of body fluids induced by heat with a restriction of liquid consumption in an effort to reduce body weight.

Rapid weight loss --- In this experiment the use of rapid weight loss refers to a period of time not more than five days or less than two days.

Semi-starvation --- The deprivation of food in the presence of a limited supply of water to reduce weight for a short period of time.

Limitations of Study

Limitations are as follows:

1. The use of four subjects makes a statistical analysis of data impossible.

2. Control of the methods of weight losses was not governed by the researcher. Three techniques were employed with each man determining to what degree he would use; (1) dehydration, (2) exercise and wrestling, (3) semi-starvation.

3. All physiological tests except endurance were administered on the day of competition to insure that maximum weight loss had been achieved. The strenuous nature of the fifteen minute run made it necessary to test endurance on the day before competition. Due to forfeits of matches, at least one endurance run was administered to each subject on the day of competition and of maximum weight loss.

CHAPTER II

Review of Related Literature

Animal study. Research in many areas started with the experimental use of animals. The number of animal studies dealing with weight loss are too numerous to include in this review. One typical experiment that used dehydration, semi-starvation and exercise of dogs will be mentioned. Young[1] and his associates controlled dog's dehydration, food intake and exercise. Their research was not concerned with weight loss entirely, but the effects of one or both elements essential to both animal and human existence. Five dogs were exercised on a treadmill with the last food and water given to them twenty-four hours before the experiment. To insure that the dogs ran to exhaustion they were periodically stimulated with an electric shocker. Results were: (1) dogs without either food and water reached their exhaustion stage after an 1191 caloric output; (2) dogs with food and without water increased their caloric output to 1299; (3) dogs without food, but with water raised their caloric output level to 2140. The investigators concluded that water supplementation maintained a relative normal

---

[1]Young, D.R., Iacovino, A., Erve, P., Mosher, R. and Spector, H., "Effect of Time after Feeding Carbohydrate or Water Supplement on Work in Dogs," _Journal of Applied Physiology_ (1959), 14:1013.

state of hydration and had a beneficial effect on carbohydrate metabolism. The effects of going without food and water for twenty-four hours had minimal effects on the normal exhaustion stages of dogs up to the time of experiments. This experiment is a link between man and animal in better understanding the effects of weight loss upon man. Although the animal studies are often the first step in research of many experimental areas the results from such studies can not be generalized to apply to humans.

General studies. Hunt[2] in his study of a Swiss mountain team concluded that dehydration was the cause of not reaching the summit. His expedition made a definite attempt to drink five to seven pints of water a day compared to one pint used by the Swiss. He found that having an abundance of water and maintaining normal hydration prevented any signs of fatigue caused by dehydration.

Mickelson[3] pointed out that the first symptom of even mild dehydration was fatigue resulting from loss of sweat during work. Normal conditioning of athletes caused mild dehydration each time a practice session ended. The absence of water after a workout caused a higher level of

---

[2]Hunt, J., A Conquest of Everest (New York: E.P. Dutton and Co., Inc., 1954), 300 pp.

[3]Mickelson, D., "Dehydration," U.S. Department of Agriculture Yearbook (1959), p. 168.

dehydration. Asher and Hodes[4] concluded that the state of dehydration occurred when water expenditure was greater than the fluid intake. Yoshimuro[5] observed a Buddhist bishop who had abstained from food and water for eight days. The bishop lost 16 per cent of his body weight and 23 per cent of his total body water. The heart was threatened with exhaustion due to the accelerated demands of the circulatory and respiratory systems. The basal metabolism increased and the body temperature raised from the onset of the religious protest. This is an extreme case which shows dangers of food and water restriction on the human body.

Mayer[6] explained the caloric requirements of athletes of different body builds. The lowest daily food intake was required by those individuals who had regular daily exercise. Individuals doing heavy conditioning work ate more and became heavier. Mayer concluded that the control of food intake and the increase in exercise can be a safe and efficient way to lose weight. This is the basic way that most coaches

---

[4]Asher, D.W. and Hodes, H.L., "Studies in Experimental Dehydration," American Journal of Technology, V (November 1939), pp. 316-334.

[5]Yoshimuro, Hisato, "A Contribution to the Knowledge of Dehydration of Human Body," Journal of Biochemistry, XL (July 1953), pp. 361-374.

[6]Mayer, Jean, "Exercise and Weight Control," Science and Medicine of Exercise and Sports (New York: Harper, 1960), pp. 301-310.

recommend to their athletes for weight control. Taylor[7] studied the effect of 10 per cent weight loss on strength and oxygen debt capacity. His results indicated that strength and maximal oxygen intake per kilogram of body weight showed no decrease up to a loss of 10 per cent in body weight.

Summary. The studies examined all show that dehydration and starvation have a definite physiological effect on man when carried to extremes. The restriction of food and water for any long period of time is not a practice used or approved by individuals in the wrestling area. Taylor[8] showed that there was no marked effect on strength and oxygen debt from weight losses up to 10 per cent of body weight. His subjects were not conditioned athletes and this factor could make the significance lower.

Wrestling studies. In 1940, Gillum[9] did an experiment which measured the strength of eleven Ohio State University wrestlers using the Rogers Physical Fitness Index. The tests

---

[7]Taylor, H.L., "Performance Capacity and Effects of Calorie Restriction with Hard Physical Work on Young Men," Journal Applied Physiology (1957), 10:421-429.

[8]Ibid.

[9]Gillum, O.C., "The Effects of Weight Reduction on the Bodily Strength of Wrestlers" (unpublished Master's thesis, Ohio State University, Columbus, 1940), 59 pp.

were given to the wrestlers twice a week, once on Monday and once on Friday. The wrestlers on Monday weighed approximately their competitive weight and on Friday the exact competition weight was required. Results showed that in the majority of the cases the strength after weight loss was greater than the strength on Monday. Gillum[10] concludes that the wrestlers after weight reduction were stronger in proportion to their body weight. The Rogers Physical Fitness Index showing greater improvement after weight loss could from one period of time to the next vary enough to show a significant change in strength.

Tuttle[11] three years later did one of the most complete studies of the effect of weight loss on the physiological responses of wrestlers. The two methods used to lose weight were dehydration and semi-starvation which were voluntarily chosen by his subjects. Thirteen wrestlers began the experiment with only six subjects completing the entire study. To establish a representative group of scores under normal weight conditions, five physiological measures were taken. The intended weight loss was five per cent of body weight, but the actual loss ranged from 3.6 to 4.9

---

[10] Ibid.

[11] Tuttle, W.W., "The Effect of Weight Loss by Dehydration and the Withholding of Food on the Physiologic Responses of Wrestlers," Research Quarterly, XIV (May 1943), pp. 158-167.

per cent. Results showed: (1) that weight loss had no effect upon strength; (2) systolic and diastolic blood pressure was not influenced by weight loss; (3) the heart rate after weight loss was higher in every case; (4) weight loss caused no deviation from normal recovery; (5) a slight reduction of vital capacity was noted. He concluded that weight loss up to five per cent has no significant effect on physiological responses of wrestlers.

Doscher[12] in 1944 used observational research in getting the opinions of experts in the field of wrestling and boxing. The experts were college coaches who have had the greatest success in wrestling and boxing. Thirty-two questionnaires out of forty were returned with twenty-eight being wrestling coaches and the other four boxing coaches. The questionnaire asked whether weight loss impaired or improved performance and health of athletes. Fifteen were for weight loss, fifteen against weight loss and two were undecided. In general, all coaches agreed that weight loss of five per cent had no harmful effect on performance or health of college wrestlers and boxers.

Observations were reported by Edwards[13] who recorded

---

[12]Doscher, Nathan, "The Effect of Rapid Weight Loss Upon the Performance of Wrestlers and Boxers, and Upon the Physical Proficiency of College Students," Research Quarterly, XV (1944), pp. 317-324.

[13]Edwards, Jennings B., "A Study of the Effect of

the number of push-ups, number of pull-ups, right and left hand grip strengths, maximum time of running on a treadmill, heart rate, blood pressure and blood lactate level of only four subjects. Three of these lost a mean of 6.37 per cent of their body weight during a seven-day period, while the other served as the control. No significant changes were noted in the strength tests, but the subjects making weight decreased an average of thirty per cent in the time of the treadmill run. Physiological findings were inconsistent and inconclusive. The small sample and the short time involved in the study make the findings difficult to evaluate.

Byram[14] experimented with fourteen wrestlers, seven in an experimental group and seven in the control group. The experiment measured the muscular endurance (ability to repeatedly flex a segment of the body against a resistance) and circulatory-respiratory endurance (Carlson Fatigue-Curve Test) of a group of wrestlers before and after making weight and compared them with a control group who did not make weight. The data collected over a period of seven weeks showed no evidence that weight reduction up to 11.04 per

---

Semi-starvation and Dehydration onStrength and Endurance with Reference to College Wrestling" (unpublished Master's thesis, University of North Carolina, Chapel Hill, 1951), 42 pp.

[14]Byram, Howard M., "Effects of Weight Reduction on Strength and on Muscular Endurance" (unpublished Master's thesis, State University of Iowa, Iowa City, 1953), 12 pp.

cent of body weight had any detrimental effects on the strength, the muscular endurance, or the circulo-respiratory endurance of the college wrestlers tested.

In 1954 Schuster[15] studied the effects of rapid weight reduction on endurance. One half of his subjects were required to lose approximately ten pounds per man in a seven-day period, the other half served as controls. Criteria were the number of push-ups and squat-thrusts the subjects could perform and the number of miles they could ride on an ergocycle. There were no significant differences in performance before and after reducing. His conclusions were that the loss of weight had no effect on wrestling ability.

Nichols[16] studied the effects of weight loss upon reaction time, balance in motion, endurance and the development of power. The study took a period of two and a half months using forty-two subjects. An experimental group and a control group was the basis of comparison on possible weight loss effects. The subjects voluntarily lost weight ranging from 1.67 per cent to 13.66 per cent, an average of

---

[15] Schuster, Abraham L., "The Effects of Rapid Weight Reduction on the Endurance and Performance of Wrestlers" (unpublished Master's thesis, Pennsylvania State University, University Park, 1954), 37 pp.

[16] Nichols, Harold J., "The Effects of Rapid Weight Loss on Selected Physiologic Responses of Wrestlers" (unpublished Doctoral dissertation, University of Michigan, Ann Arbor, 1957), 101 pp.

6.78 per cent of the body weight. An 8 per cent or greater loss of body weight was recorded on 33.8 per cent of all measures recorded. There were five instances in which wrestlers reduced their body weight by more than 10 per cent. In each case the test means favored the wrestler with reduced body weight. The conclusions were: (1) weight loss did not materially affect the wrestler's strength; (2) reaction time was not hindered because of weight loss; (3) the ability of the wrestler to maintain balance while in motion was not affected by weight loss; (4) rapid weight loss did not adversely affect the endurance of the wrestlers as evidenced by the pulse rate after exercise. This study indicated that wrestlers can lose weight up to 10 per cent of their body weight without adversely affecting the physiological responses of the subjects.

A later study completed by James[17] using interscholastic wrestlers showed an average of seven pounds lost per wrestler or 4.4 to 6.9 per cent of their body weight had no effect on the scores of the Carlson Fatigue-curve Test. The purpose of the study was to determine the effects of weight loss on pulse rate, blood pressure and performance measured by the Carlson Fatigue-curve Test. Twenty subjects

---

[17] James, Byron D., "The Effect of Weight Reduction on the Physical Condition of High School Wrestlers" (unpublished Master's thesis, State University of Iowa, Iowa City), 15 pp.

were placed in a control group and twenty in an experimental group. The series of tests were administered twice a week, once before weight loss and then again after the wrestlers had weighed in for competition. Pulse rate and blood pressure were taken after each wrestler had wrestled in competition at intervals of two minutes by a school nurse. All tests were administered to those wrestlers who completed a full six minutes of wrestling. Losing up to 6.9 per cent of body weight had no effect on these two groups of interscholastic wrestlers.

During the past four years a study has been concluded by Ahlman and Karvanen[18] which compared the effects of weight loss by using cross country running and a sweat box. Thirty-two subjects were used to check the possible effects of these two methods. The tests used checked pulse rate before and after weight loss, and strength measuring back and leg power. Weights were checked early in the morning and the first battery of tests were given. The next four hours the wrestlers reduced their weight by either of the two methods. The second battery of tests were given, followed by a light meal and three more hours of weight reduction. The final test showed a slightly higher heart rate with a

---

[18]Ahlman, K. and Karvonen, J.J., "Weight Reduction by Sweating in Wrestlers, and its Effect on Physical Fitness," The Journal of Sport Medicine and Physical Fitness, I, (Sept. 1961), p. 23-26.

slower period of recovery time following exercise. Wrestlers using cross country running showed better cardiovascular performance at the conclusion of the experiment than did those reducing in the sweat box. The effect of weight reduction on strength was not detrimental to the wrestlers. The average weight loss of 4.4 pounds obtained in this study is not sufficient in comparison to the higher per cents of total body weight obtained by other researchers.

Summary. Making weight may involve exercise, use of sweat baths, and restriction of food and water intake. It has been shown that a combination of any of the above may prove to be effective to an individual wrestler concerned with making weight.

There has been some indication that heart rate has a tendency to increase and a small decrease in the amount of vital capacity occurs after weight loss. The majority of the studies have indicated no effects on physiological responses of wrestlers in losing up to 5 per cent of body weight. Later studies show that weight losses up to 10 per cent have very little if any effect on the performances of wrestlers. The greatest weight loss experimentally recorded was over 13 per cent of the body weight which showed no detrimental effects on the physiological responses of wrestlers at that level.

CHAPTER III

Methodology

The research methodology for this study was the case study with four volunteer subjects being observed and tested at intervals throughout a varsity wrestling season.

Four volunteer subjects were selected on the following basis: (1) wrestling experience; (2) control of subjects by author as assistant varsity coach; (3) a variety of weights ranging from 130 to 191 pounds. Only four subjects were used in an effort to gain a more accurate collection of data and work with subjects whose motivation toward completing the study would be strong. The subjects used were members of the varsity squad of Oklahoma State University except for one who wrestled formerly in the Big Eight conference and was present during varsity workouts. The age of the subjects ranged from twenty-one to twenty-four years. The skill and experience level of these subjects ranges from fourth place in the Big Eight conference to an Olympic champion. Subjects will be referred to as cases for the remainder of the study.

Case One. This twenty-four year old athlete wrestled in the Big Eight for three years with third and fourth place medals at 191 pound class. During this study he had an initial weight of 216 pounds and lost weight down to 191 pounds.

Case Two. The experience of case two included both high school and three years of college competition. During this time he received honors as state high school champion, second for two years in the National Collegiate Athletic Association and first and second in Big Eight at 177 pound class. His age was twenty-two years and he planned to compete for many more years. During the time of this experiment this subject's weight ranged from 196 pounds to his wrestling weight of 177 pounds.

Case Three. At the age of twenty-three this subject has achieved state high school championships, a Big Eight championship, Amateur Athletic Union championship, second in the National Collegiate Athletic Association and fourth in the 1964 Olympics. During the study, this subject's weight ranged from 157 pounds to his wrestling weight of 147 pounds.

Case Four. This athlete at the age of twenty-one has won two Big Eight championships, two National Collegiate Athletic Association championships and was Olympic champion in 1964. This subject's weight ranged from 143 pounds to his competition weight of 130 pounds.

The achievements of the above athletes were not included just to denote wrestling skill, but to point out the age, weight and experience which helped govern the choice of subjects. These achievements also show the motivation of these athletes to perform their best at the task at hand.

The tests selected for use in this study were chosen to include a variety of physical fitness measures including cardiovascular, respiratory, endurance, strength and weight analysis. The instruments and tests used followed the suggestions or design recommended by Dr. A. B. Harrison, Associate Professor of Health, Physical Education and Recreation at Oklahoma State University. The administration of these tests followed the standard form prescribed by their authors.

The following test procedure was performed on all four cases to evaluate the possible effects of rapid weight loss upon selected physiological and motor responses. The subjects went through this test procedure five to eight times during the season. Tests were administered early in the season before weight loss began and at intervals during the season when true weight losses or gains took place.

The first test was to measure the resting blood pressure and pulse rate. A resting period of several minutes while seated in the chair was allowed so that effects of previous activity might be excluded from the test. This test has been used by Dawson[1] and others for an indication

---

[1]Dawson, P.M., "Effect of Physical Training and Practice on the Pulse Rate and Blood Pressure During Activity and During Rest, with a Note on Certain Acute Infections and on the Distress Resulting from Exercise," American Journal of Physiology, (1919), 50:433.

of cardiovascular fitness.

Schneider Index Test. The Schneider test was administered during the first part of the test period to get a broader scope of cardiovascular fitness. This test was administered according to Cureton's[2] modifications.

Vital Capacity. This test was used to give an indication of respiratory fitness. The subjects inhaled as much air as possible and made a maximal exhalation into a spirometer, with the best of two trials being recorded. The raw vital capacity scores were first corrected to S.P.B.T. values, correcting for barometric pressure and temperature according to McCloy's[3] table. These corrected scores were then used in calculating the vital capacity residuals according to Cureton's[4] formula.

Analysis of Weight. Cureton's[5] means of predicting weight was included to study bone and muscle proportions of the subjects. The tests used were measurement of skeletal

---

[2]Cureton, T.K., Physical Fitness Workbook (St. Louis: C.V. Mosby, 1947), 150 pp.

[3]McCloy, C.H., "On Using the Spirometer as an Instrument of Precision," American Physical Education Review (1927), 32: p. 326.

[4]Cureton, T.K., Physical Fitness Appraisal and Guidance (St. Louis: C.V. Mosby Company, 1947), p. 139-151.

[5]Ibid.

size and measurement of muscular girths with muscles tensed to predict weight of the body. Sample weight analysis form is included in appendix for components being measured.

Fat Measurements. The three sites for measurements of subcutaneous fat levels were triceps, subscapular and abdominal each used by Lederle Laboratories[6]. Each of these positions have gained universal acceptance as being an indicator of fat level throughout the body. The Lange Skinfold Fat Calipers were used to make these measurements.

Strength Measurements. Grip strength was measured with a cable tensiometer with grip strength attachment. The subjects were allowed two trials with each hand, the best trial being recorded. To measure arm strength the grip dynamometer with push-pull attachments was used. These measurements were also taken from the best of two trials.

Back and leg strength was measured with a device suggested by Heintz[7]. This device is illustrated in Figure 1. The only modification used was that of using a cable tensiometer for the strength reading instead of a bathroom scale. Standard positions used were those proposed by

---

[6] The Skinfold Test, (New York: Lederle Laboratories, 1962), 21 pp.

[7] Heintz, Mary, "Device for Testing Back Strength," Research Quarterly (1962), 33:638.

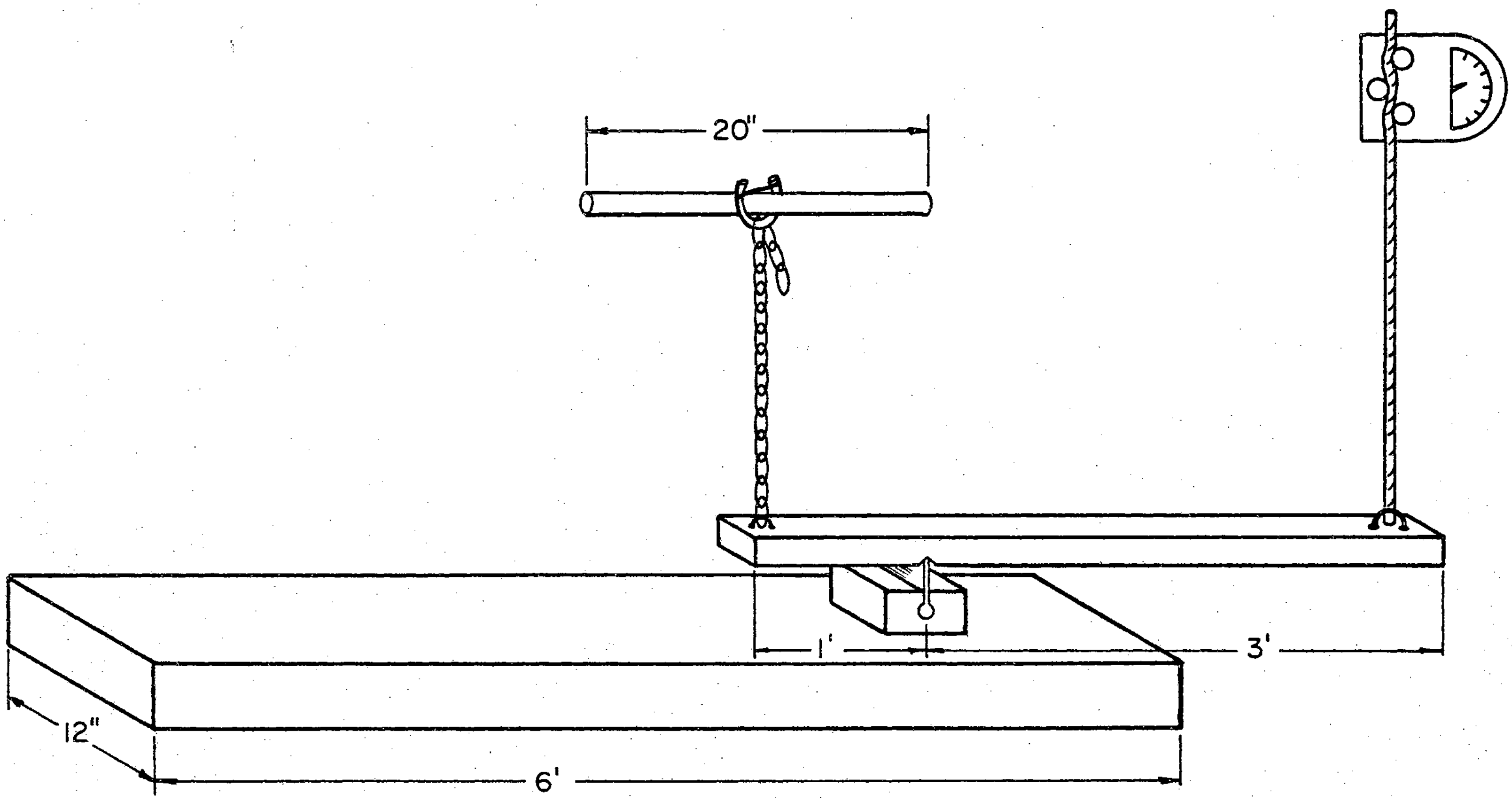

Figure 1. Tennometer for testing back and leg strength

Cureton[8] to measure leg and back strength.

Fifteen Minute Endurance Run. The fifteen minute run, designed by Balke[9] was included to get a measure of metabolic functional capacity. A 160 yard oval indoor track marked off in twenty yard intervals was used for the run. The subjects ran for fifteen minutes with time and laps announced to each athlete at the completion of a full lap. The object was to cover as much distance as possible in fifteen minutes. After fifteen minutes each runner was stopped and his total distance covered marked on a score sheet. Later calculations indicated average speed for the run and oxygen utilization from Balke's[10] prediction graph.

Treatment of Data. The analysis of data was conducted on an individual case method. All raw data was placed on graphs and observed for tendencies of each test. The individual test scores and means for high and low weight days were plotted graphically with responses noted as to weight gain or weight loss. Mean test scores of all four subjects on high weight and low weight days were tabulated and graphed for comparison.

---

[8] Ibid., pp. 363-365.

[9] Balke, B., "A Simple Field Test for the Assessment of Physical Fitness," (Oklahoma City: Civil Aeromedical Research Institute, 1963), 8 pp.

[10] Ibid., p. 3.

CHAPTER IV

Results

Case One. This athlete lost 10.75 per cent of body weight on two occasions. These responses constitute low weight scores. There were five tests given on high weight days. A comparison between the mean scores of low weight days and high weight days produced the following results. No apparent differences were found between high and low weight test scores on the cardiovascular efficiency tests. Low weight scores showed an improvement of eighteen cubic inches over the high weight scores in vital capacity. As expected, fat measurements showed a higher reading of fat on high weight days than during low weight days. Of the three locations selected for fat measurements the greatest difference between the low and high weight measures was found at the subscapular. Strength measurements indicated no harmful effects of rapid weight loss upon strength. The fifteen minute run for endurance showed higher scores for distance ran, speed of run and estimated oxygen intake on the low weight days. The findings for this case indicated that rapid weight loss had no effects upon the physiological responses tested in this experiment.

Each individual test and its response is noted on Table I and plotted on Figures 2 through Figure 15.

TABLE I

CASE ONE

Dates	Dec. 16	Jan. 7	Jan. 15	Jan. 20	Feb. 2	Feb. 12	Feb. 15	Mean Low Weight	Mean High Weight
Weights	214	206	192	202	206	206	191		
Resting Blood Pressure	125/90	118/75	120/80	120/86	118/82	120/80	117/75	118/77	120/82
Resting Pulse Rate	60	60	58	62	58	50	54	56	58
Schneider Index	9	16	16	17	18	20	16	17	16
Vital Capacity Residuals	-38	-36	-13	-23	-46	-52	-30	-21	-39
Predicted Weights									
Skeletal	188.2	189	186	188.6	188	189.2	187.6	186.3	188.6
Muscular	184.6	177	174.3	181.3	177.2	178	178.2	176.3	179.6
Fat Measurements									
Triceps	12.5	12	10	11	12.1	12	10	10	11.9
Subscapular	16.5	16	12	14.2	15	15	12.2	12.1	15.3
Abdominal	15.5	15	11	12.5	12.6	12	10.9	10.9	13.5
Strength Measures									
Right Hand	140	140	141	140	138	137	140	140.5	139
Left Hand	145	143	144	150	152	148	138	141	147.6
Push	186	176	182	180	182	180	170	176	180.8
Pull	162	130	148	130	126	120	140	144	133.6
Legs	354	384	360	372	372	384	396	378	373.2
Back	479	420	438	436	432	474	420	429	448.2

Fifteen Minute Run

Dates	Dec. 15	Jan. 6	Jan. 14	Jan. 19	Feb. 1	Feb. 12	Feb. 15		
Distance (Meters)	2642	2761	2991	2936	3092	3018	3009	3000	2952
Speed	176	184	199	196	201	201	201	200	196.7
Est. Oxygen Intake M/Min.	42	44	45.5	44.2	46.2	45.7	45.7	45.6	45

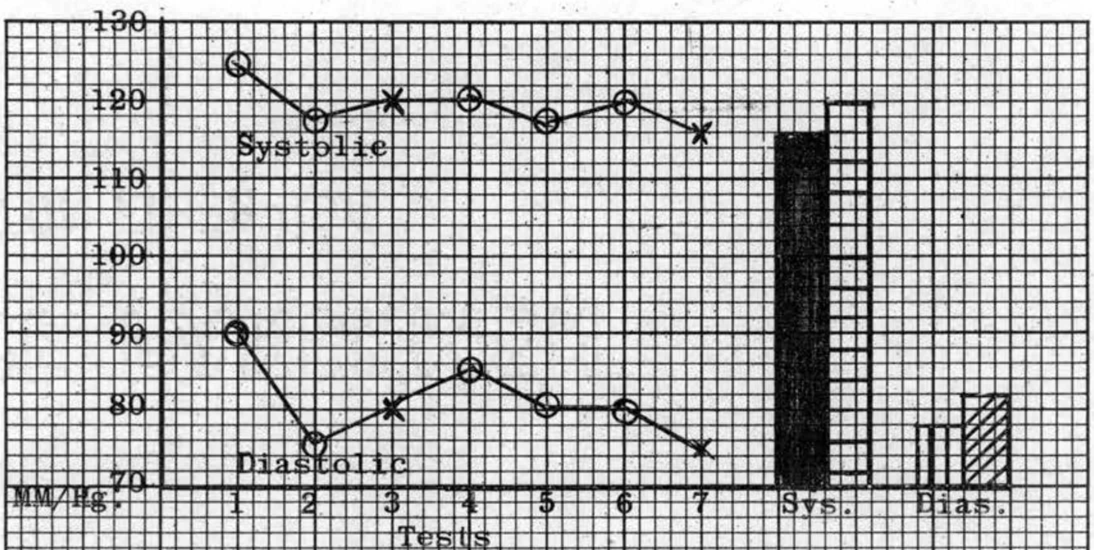

Figure 2. Resting blood pressure

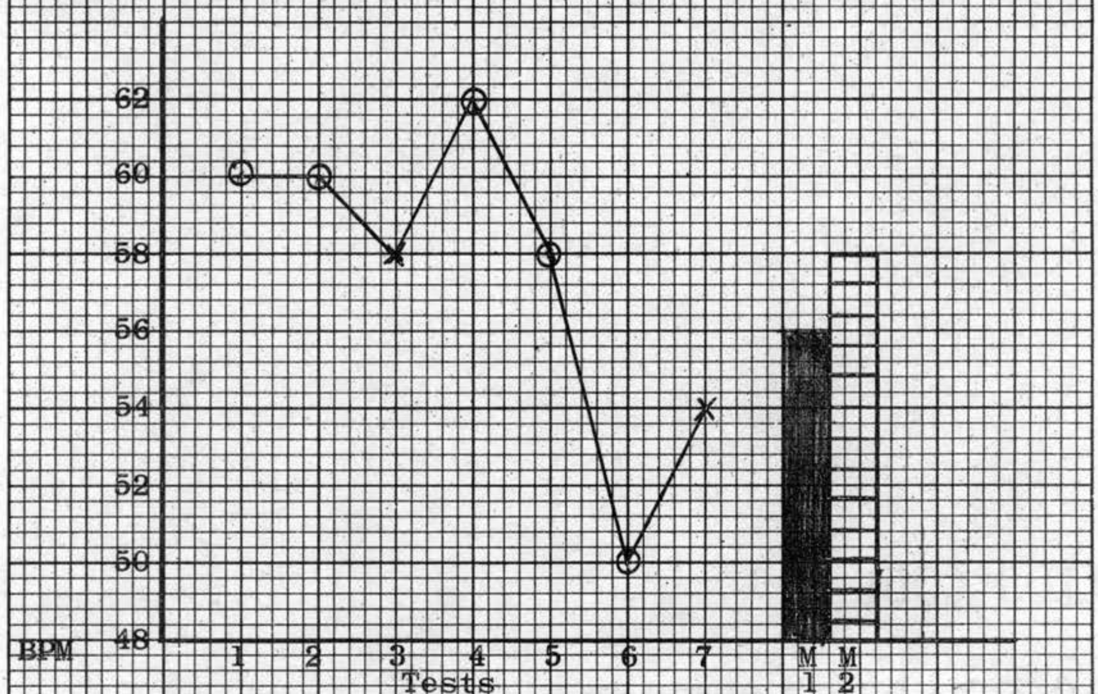

Figure 3. Resting Pulse rate

Low Weight 1=X=
High Weight 2=0=

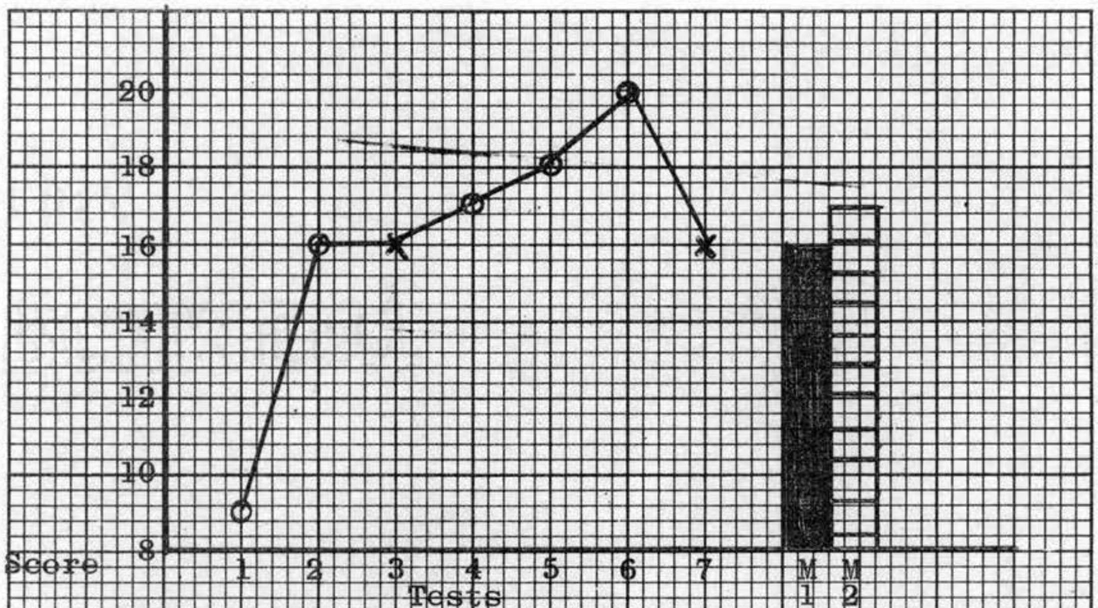

Figure 4. Schneider Index Test

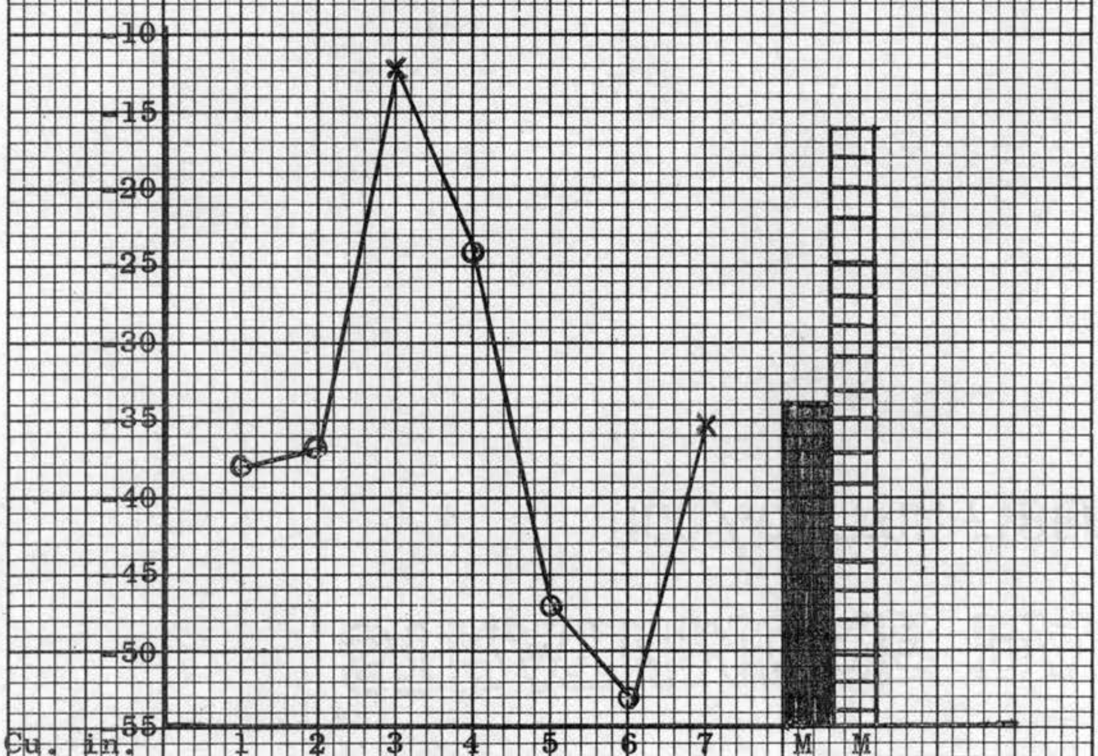

Figure 5. Vital capacity residuals

Low Weight 1=X=

High Weight 2=0=

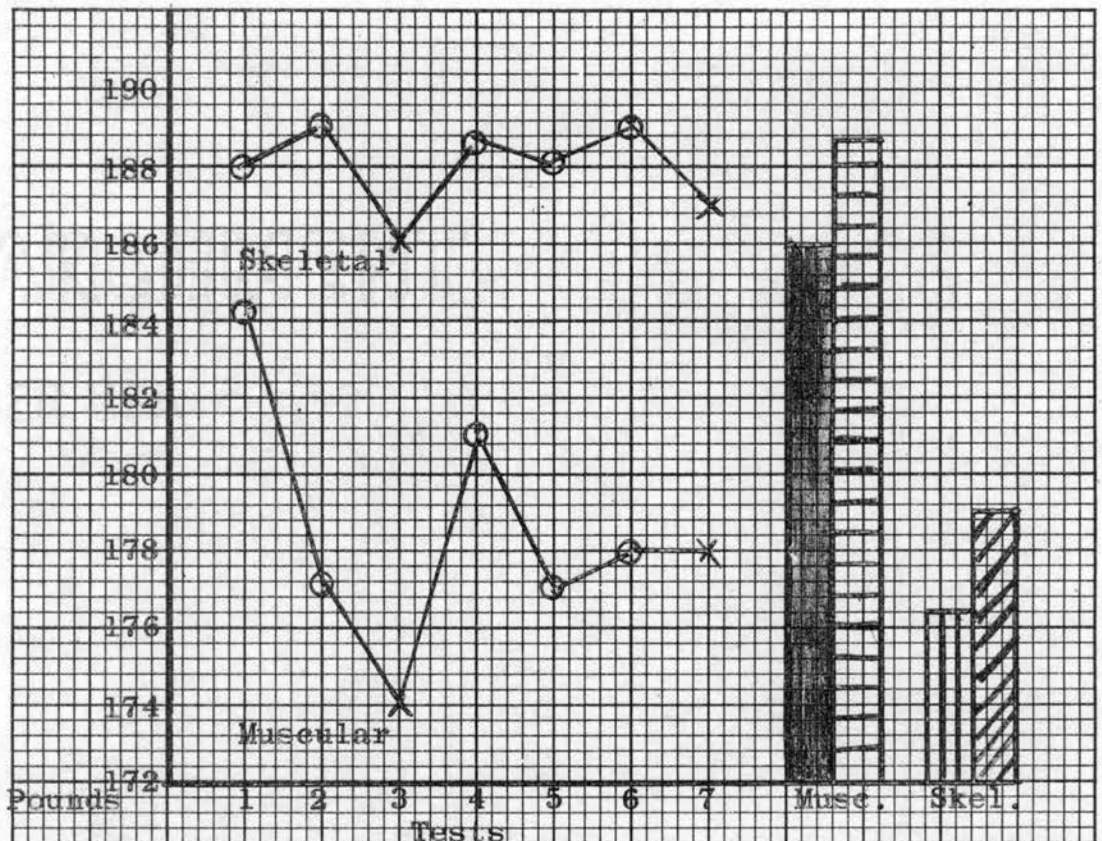

Figure 6. Predicted skeletal-muscular measures

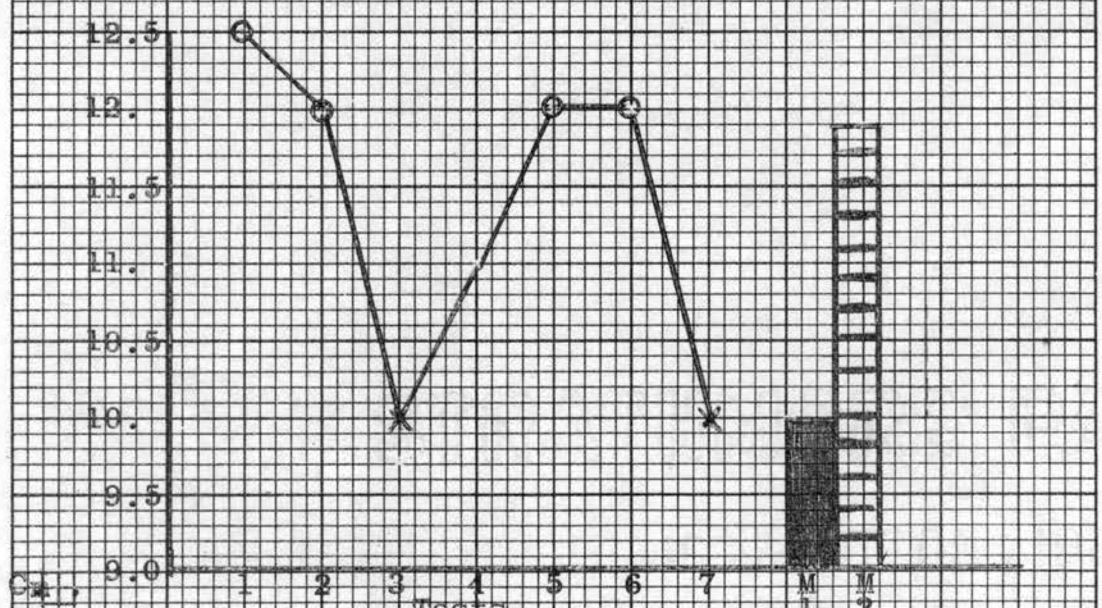

Figure 7. Triceps fat measurements

Low Weight 1=X=
High Weight 2=0=

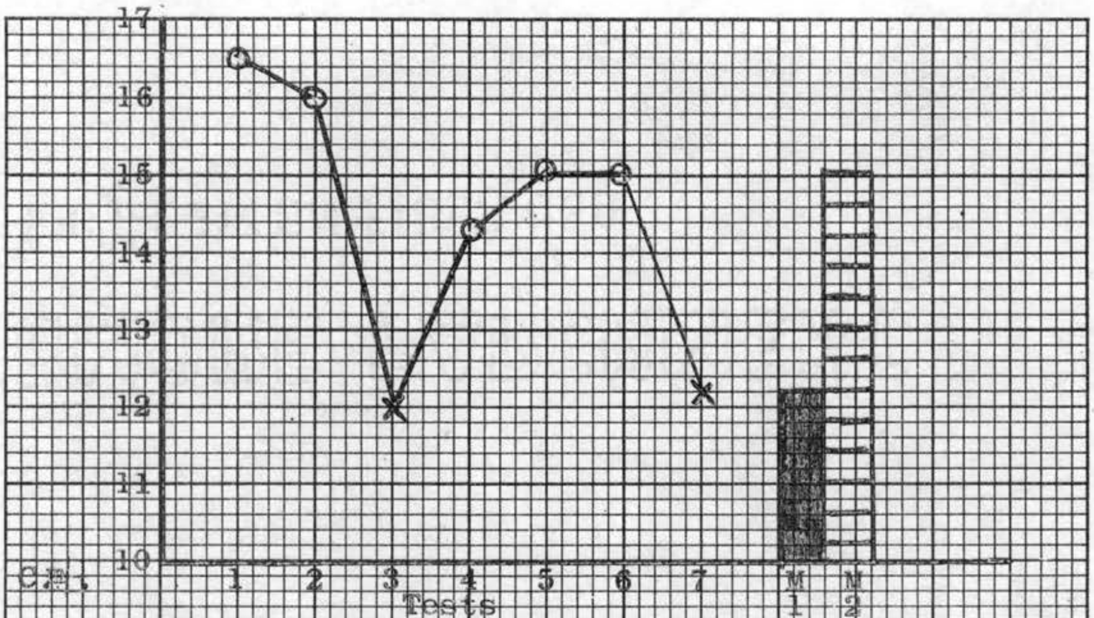

Figure 8. Subscapular fat measurements

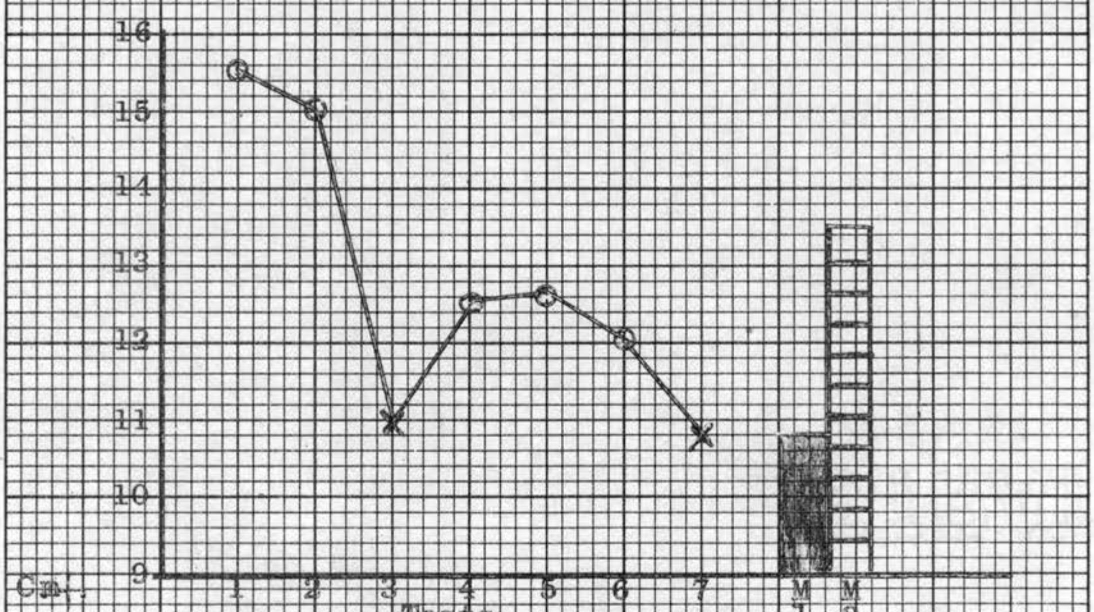

Figure 9. Abdominal fat measurements

Low Weight 1=X=

High Weight 2=0=

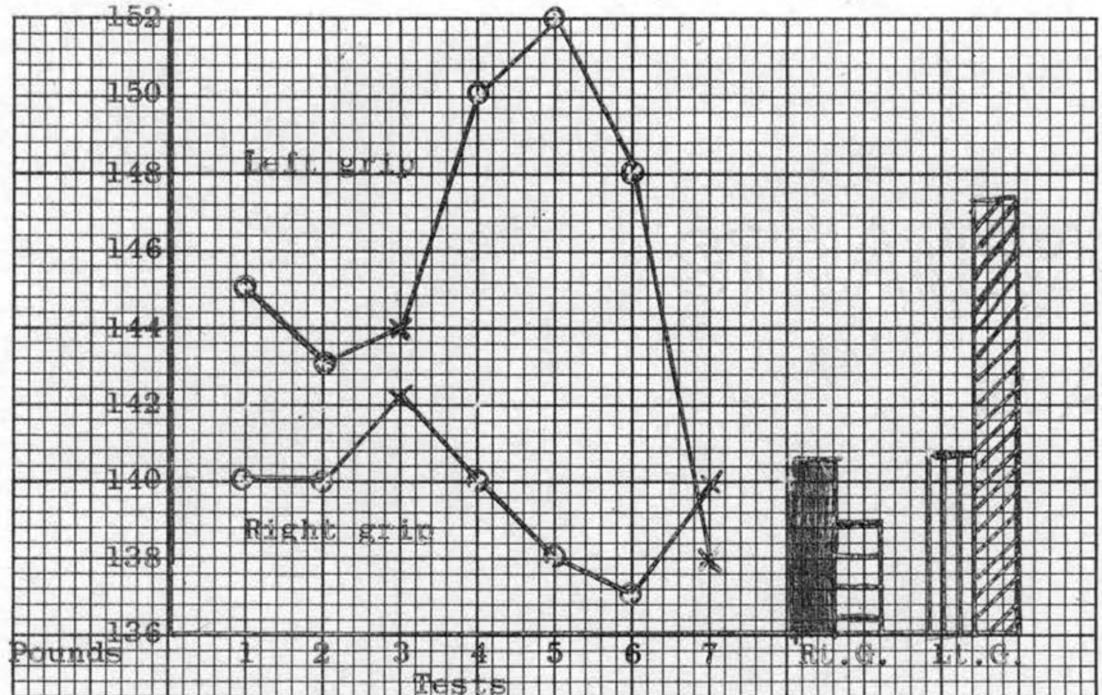

Figure 10. Grip strength measurements

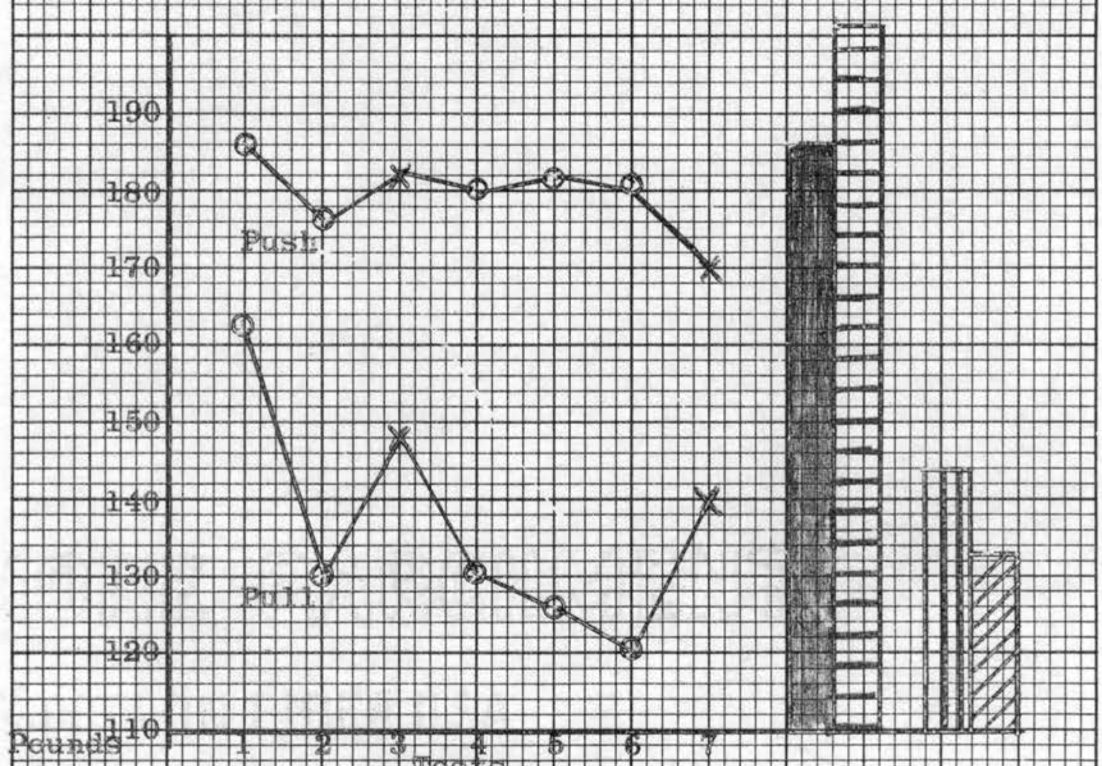

Figure 11. Push-pull strength measurements

Low Weight 1=X=
High Weight 2=0=

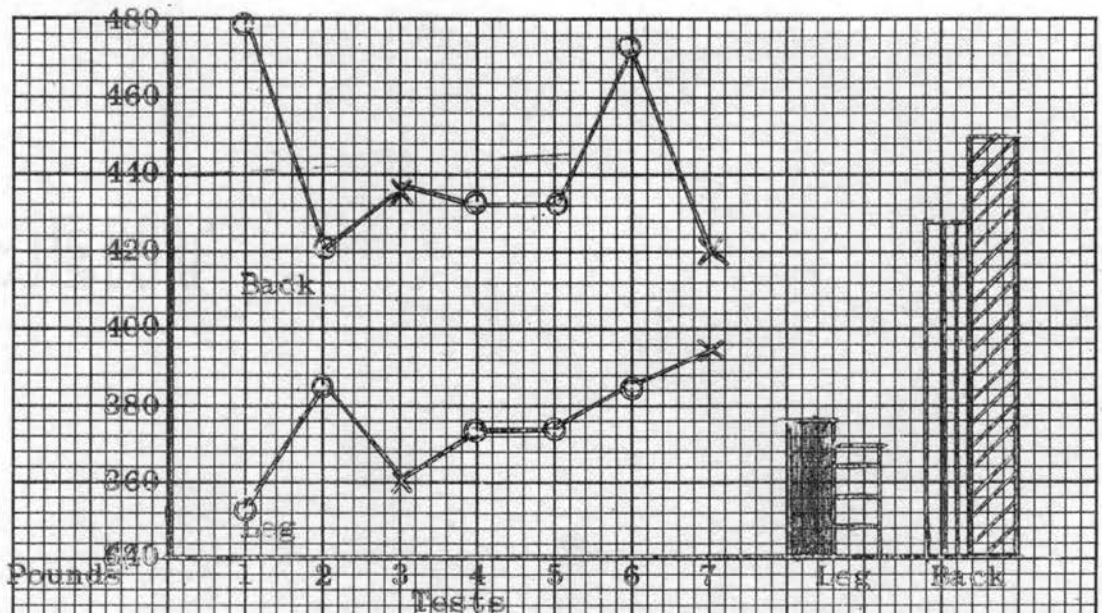

Figure 12. Leg & back strength measurements

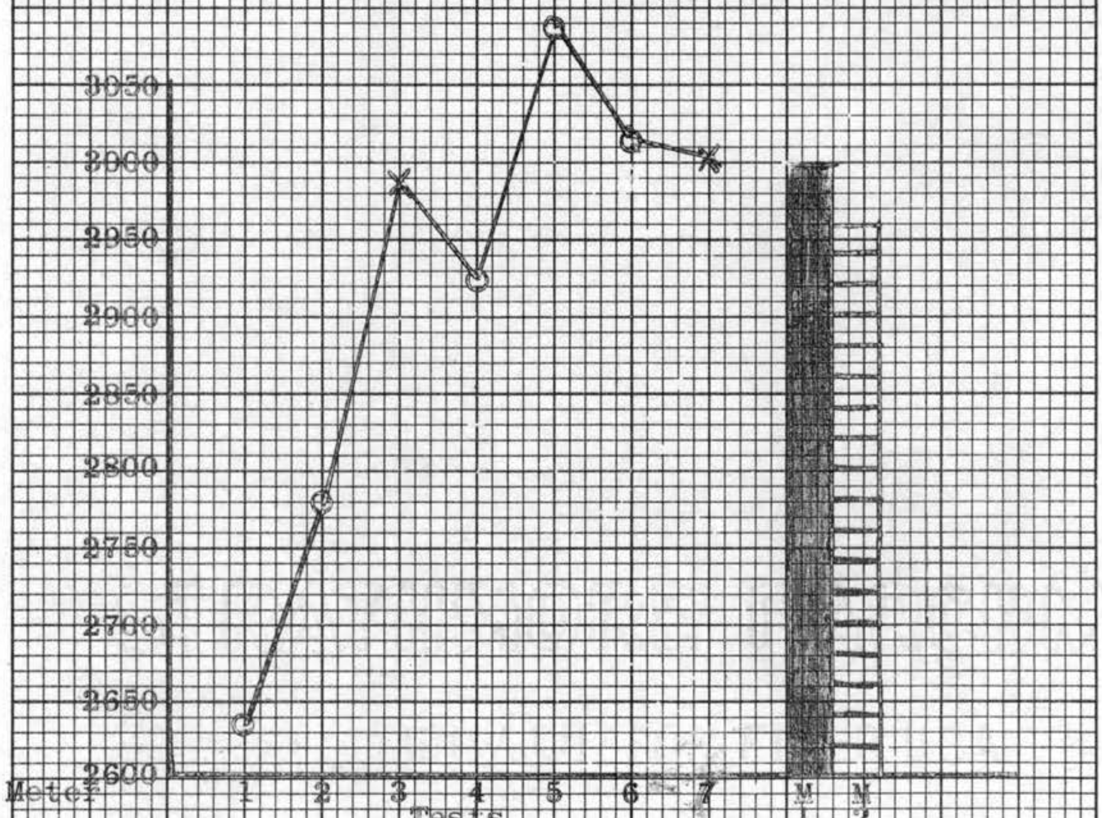

Figure 13. Distance of fifteen minute run

Low Weight 1=X=

High Weight 2=0=

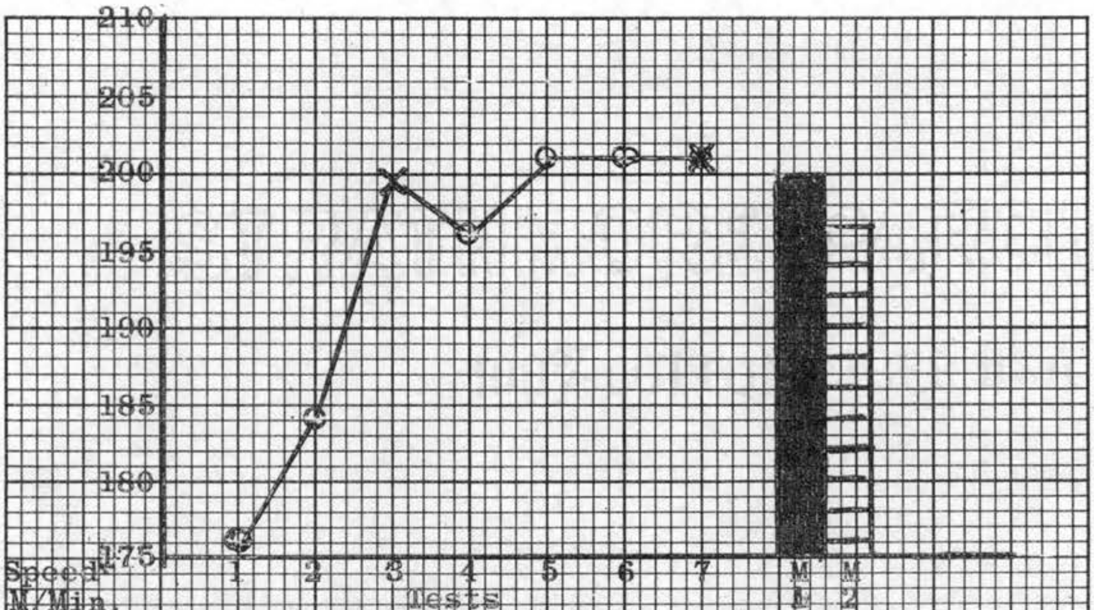

Figure 14. Speed of fifteen minute run

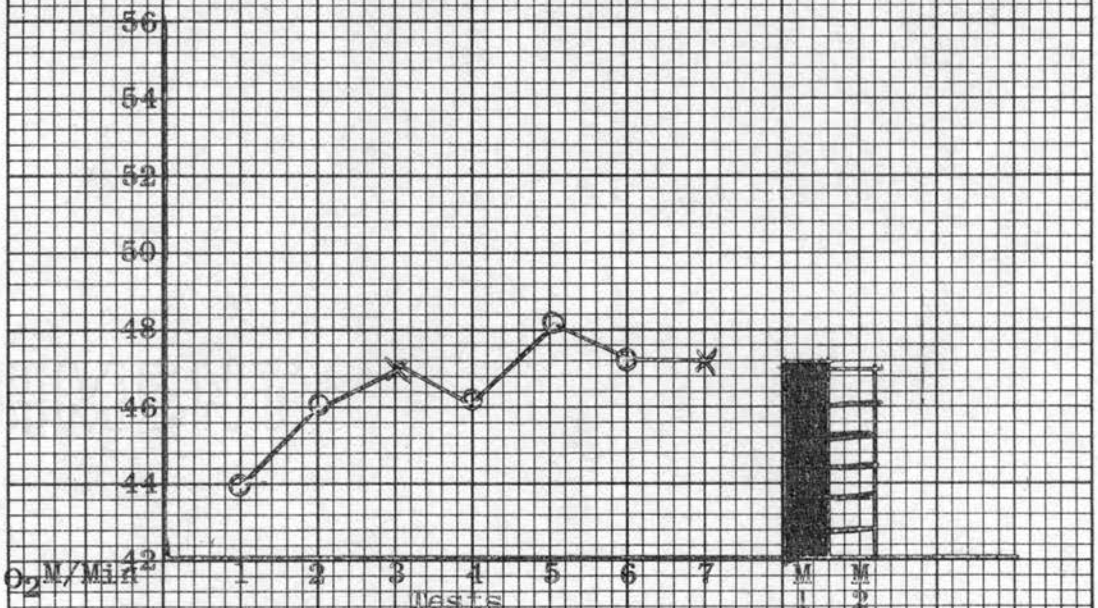

Figure 15. Estimated oxygen intake

Low Weight 1=X=
High Weight 2=0=

Case Two. This athlete lost 9.23 per cent of his body weight to wrestle in competition. The eight tests completed on this subject included three on low weight days and five on high weight days. The following results represent the comparison between high weight and low weight test scores. Higher scores on low weight days were apparent for resting pulse rate, Schneider Index and vital capacity residuals. The skeletal weight prediction measurements predicted a higher weight for both low and high weight days than did the muscular measurements. Subscapular fat measurements varied the greatest of three selected body locations for fat measures. Weight loss did not cause any harmful effects on the strength of wrestler. Distance ran, speed of run and oxygen intake showed marked difference between low weight days and high weight days. The fifteen minute run low weight responses were all greater than high weight responses. Physiological tests of this subject indicated that rapid weight loss had no harmful effects on essential components of a wrestler.

Each individual test and its response is noted on Table III and plotted on Figures 16 through 29.

TABLE II

CASE TWO

Dates	Dec. 17	Jan. 7	Jan. 19	Jan. 29	Feb. 2	Feb. 13	Mar. 2	Mar. 12	Mean Low Weight	Mean High Weight
Weights	195	182	185	177	182	177	176	184		
Resting Blood Pressure	118/70	120/70	120/70	124/68	124/68	120/66	122/72	120/70	122/69	120/70
Resting Pulse Rate	64	60	64	48	50	48	44	48	46	57
Schneider Index	13	12	15	22	21	22	20	22	21	16
Vital Capacity Residuals	24	15	20	11	15	9	-.86	7	16	9
Predicted Weights										
Skeletal	176.1	167	182	171	181	170	172	178	171	176
Muscular	168	159	155	151	158	152	154	159	152	161
Fat Measurements										
Triceps	8	9	7	5	5	5	6	5	5	6
Subscapular	9	8	7.5	5	6	5	7	6	5.6	7.3
Abdominal	10	8	9	10	9	9	10	9	9.5	9
Strength Measures										
Right Hand	163	170	138	152	154	168	177	162	166	157
Left Hand	160	158	162	152	153	140	157	162	154	159
Push	185	205	210	190	198	186	196	196	191	199
Pull	165	130	190	174	172	148	170	162	164	164
Legs	534	534	549	504	516	520	535	518	519	530
Back	405	405	390	392	388	386	366	386	381	395

Fifteen Minute Run

Dates	Dec. 16	Jan. 6	Jan. 18	Jan. 28	Feb. 1	Feb. 13	Mar. 1	Mar. 11		
Distance (Meters)	3523	3541	3807	3945	3848	3862	3853	3871	3887	3718
Speed	235	236	254	263	256	257	257	258	259	248
Est. Oxygen Intake M/Min.	50	51	54	56	54	55	55	55	55	52

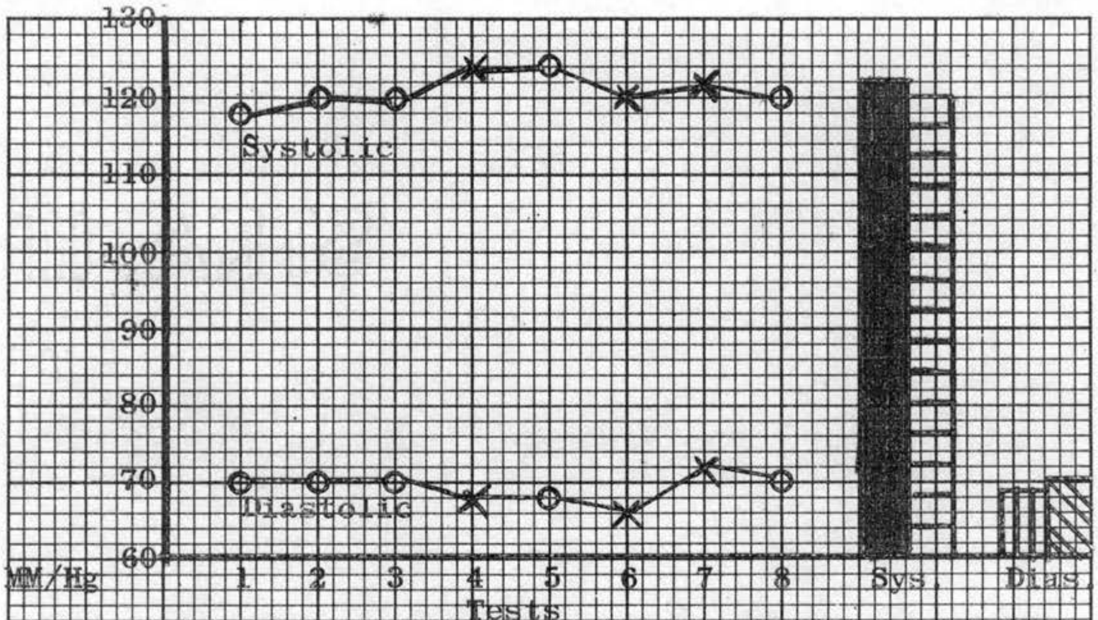

Figure 16. Resting blood pressure

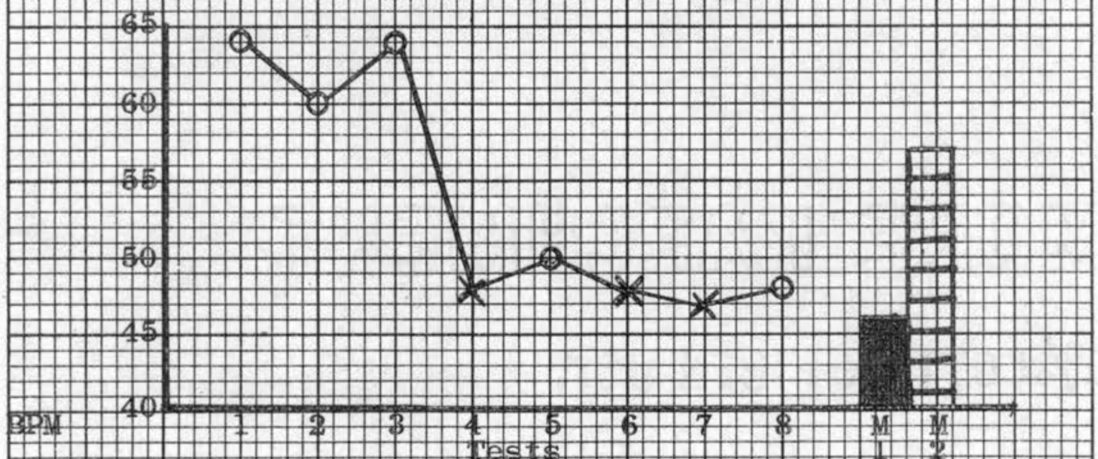

Figure 17. Resting pulse rate

Low Weight 1=X=

High Weight 2=O=

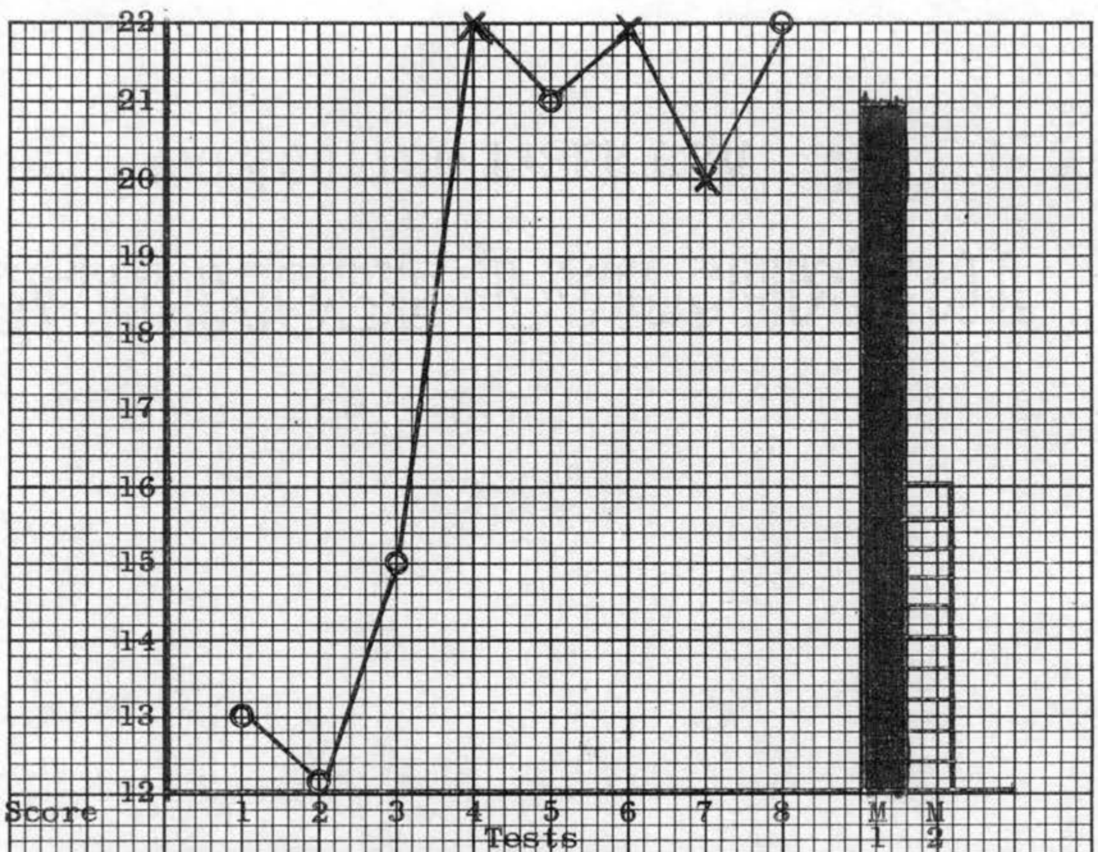

Figure 18. Schneider Index Test

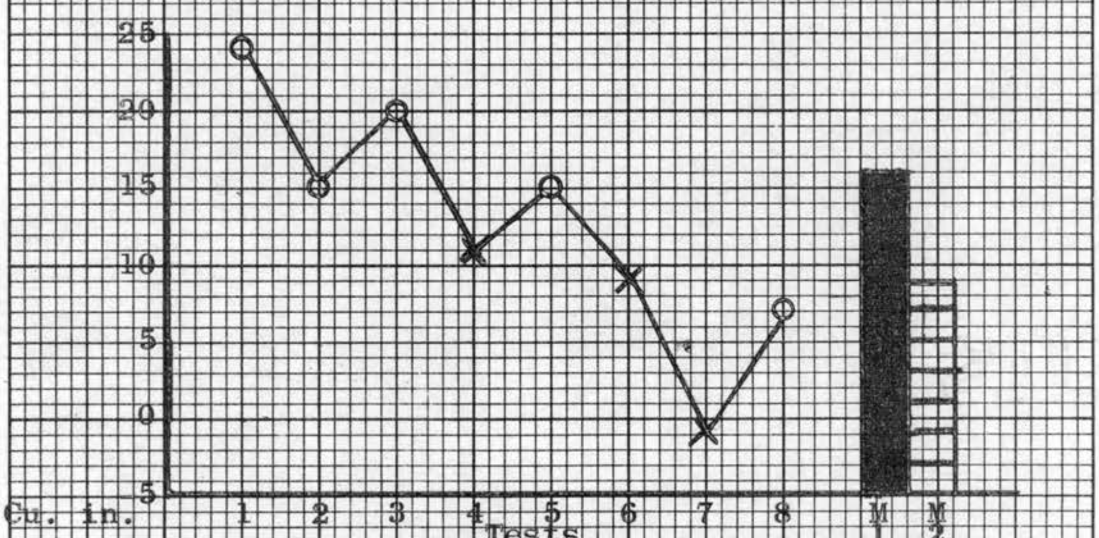

Figure 19. Vital capacity residuals

Low Weight 1=X=

High Weight 2=0=

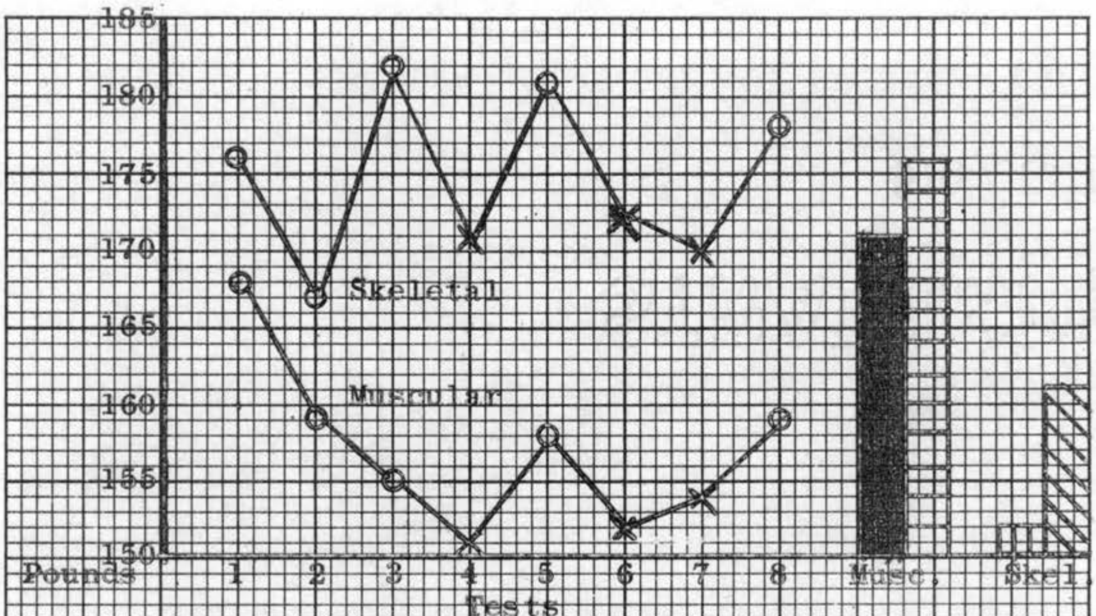

Figure 20. Predicted skeletal-muscular measurements

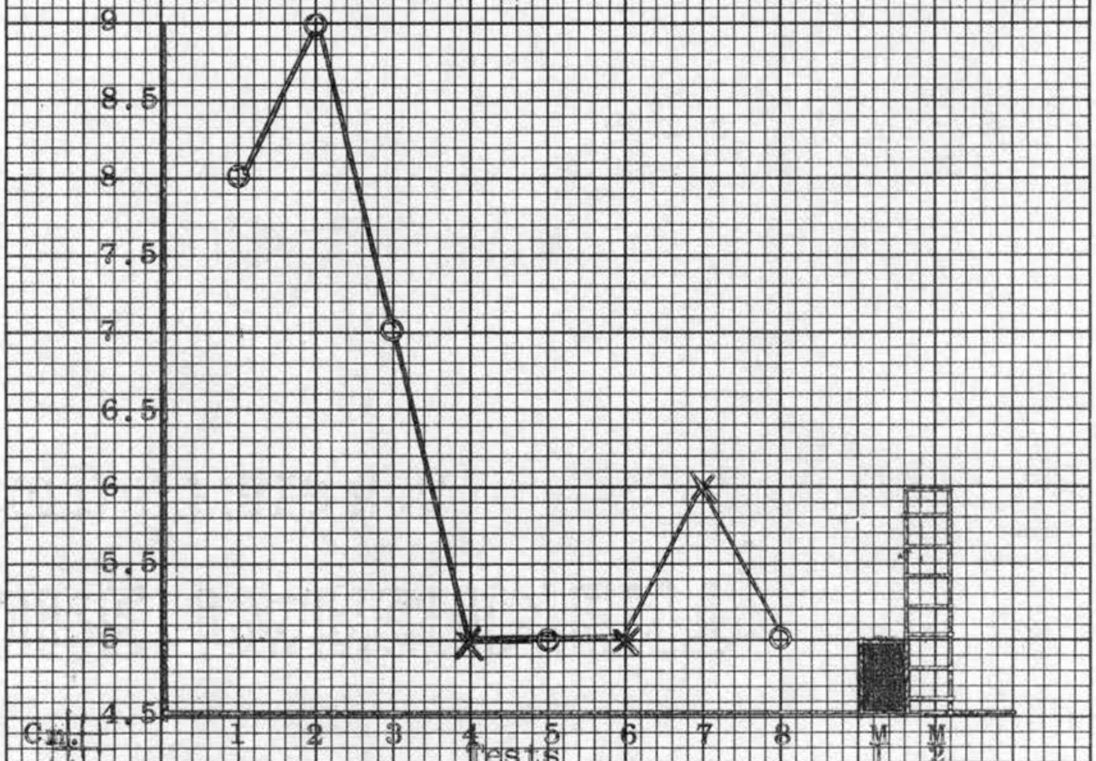

Figure 21. Triceps fat measurements

Low Weight 1=X=■ ▥
High Weight 2=0=⊖ ▧

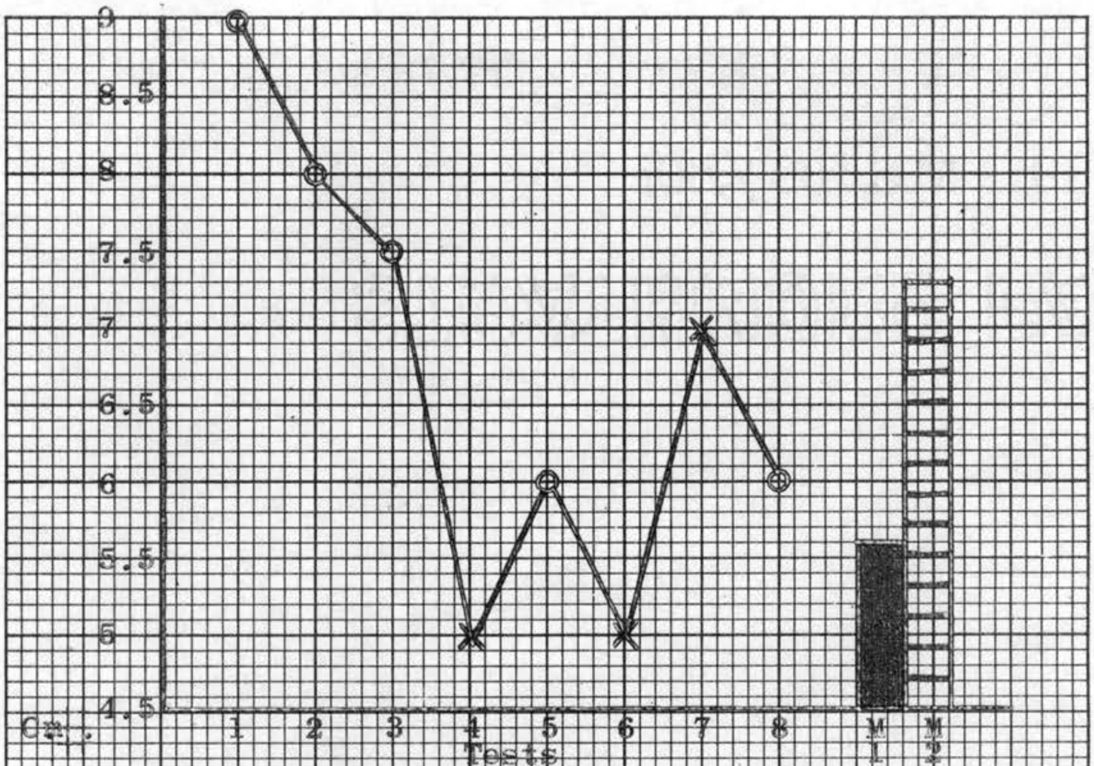

Figure 22. Subscapular fat measurements

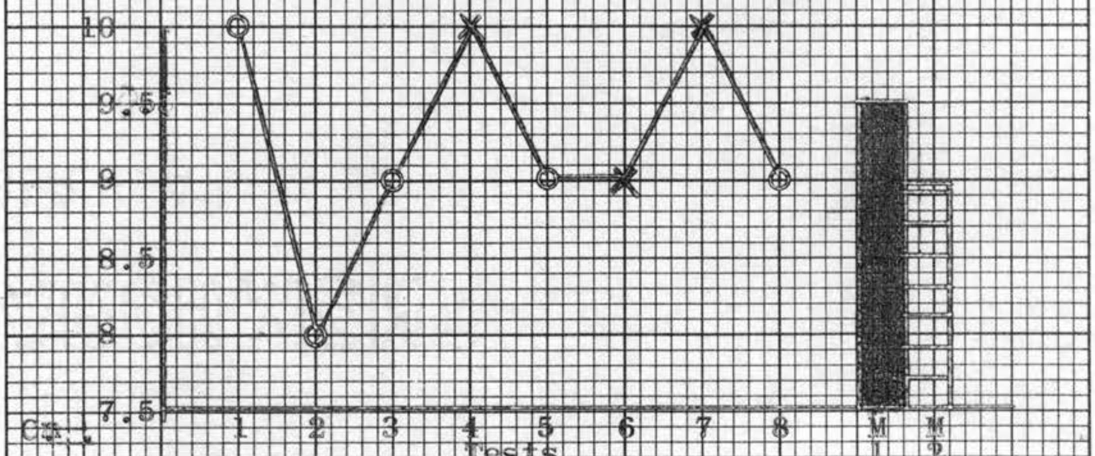

Figure 23. Abdominal fat measurements

Low Weight 1=X=
High Weight 2=0=

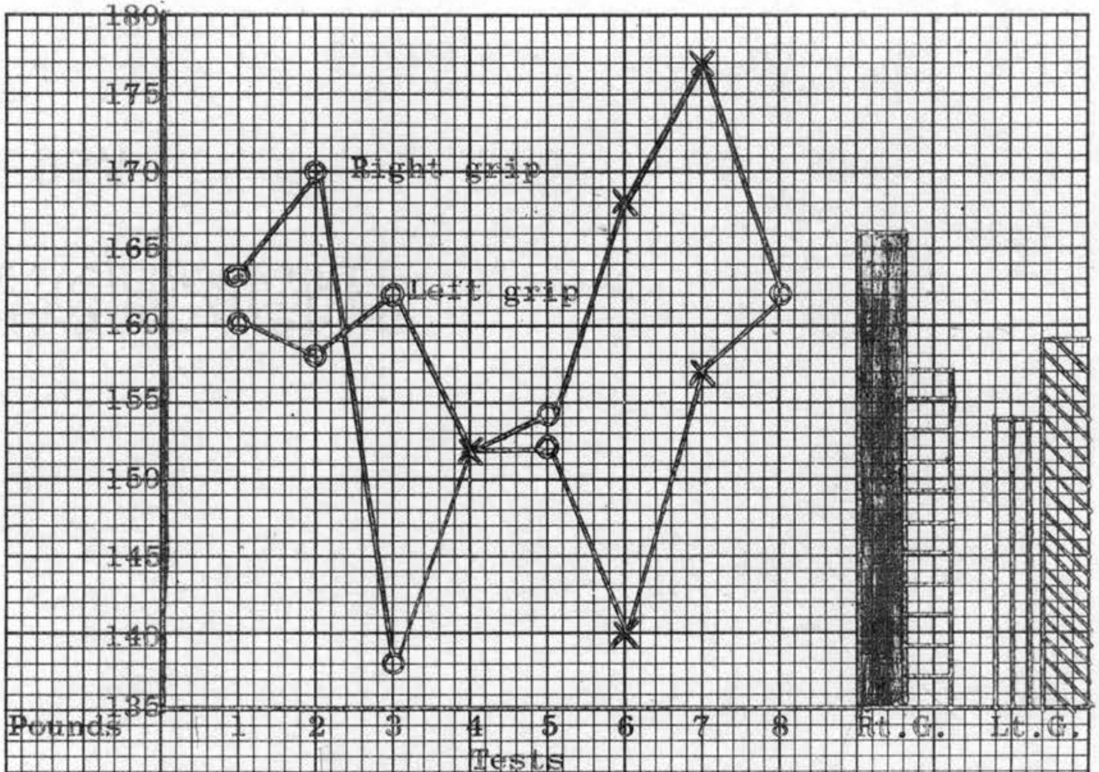

Figure 24. Grip strength measurements

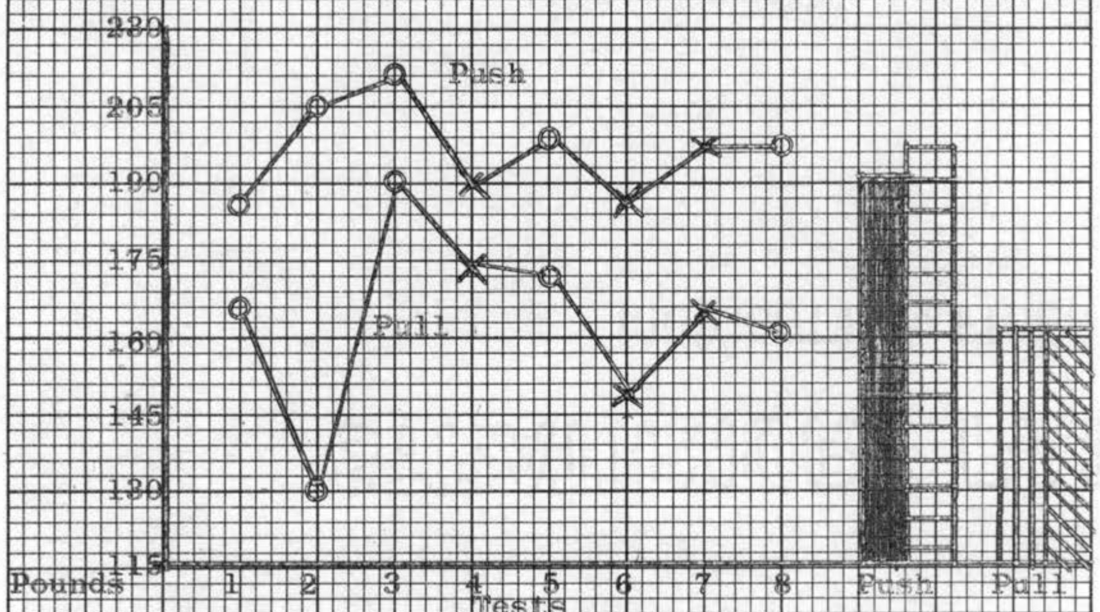

Figure 25. Push-pull strength measurements

Low Weight 1=X=
High Weight 2=O=

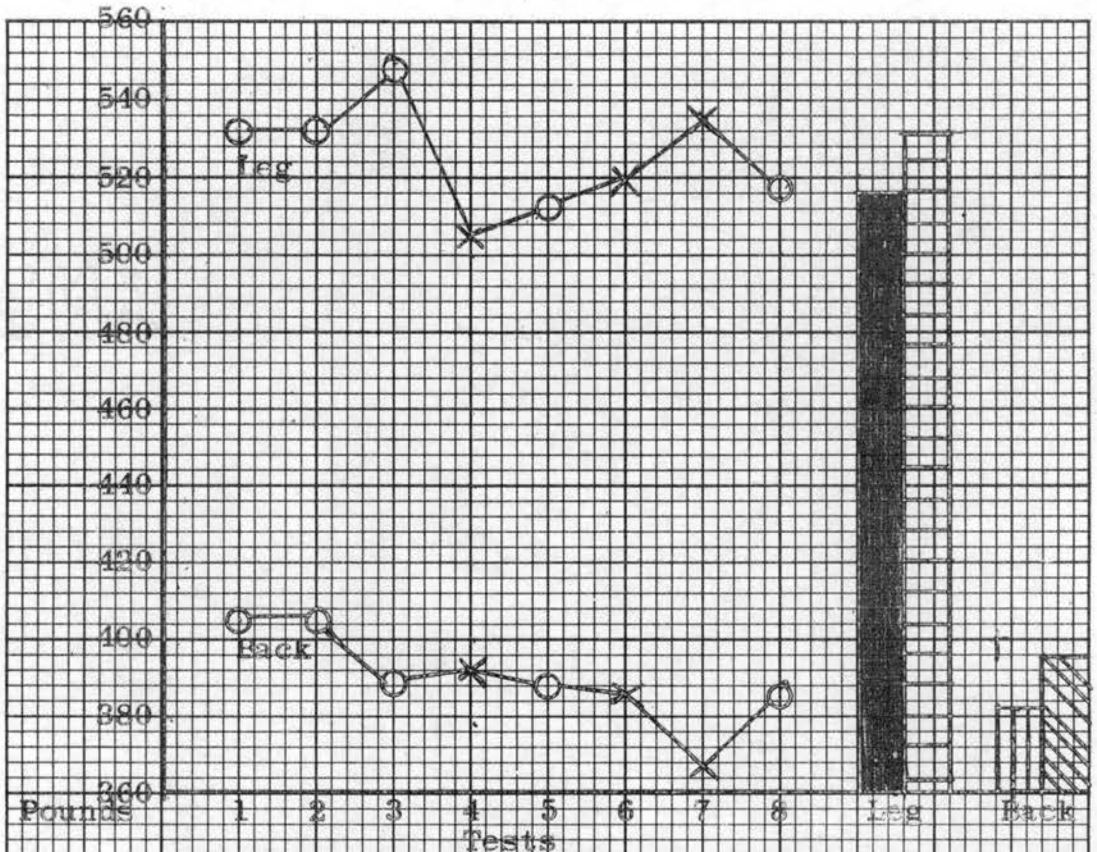

Figure 26. Leg & back strength measurement

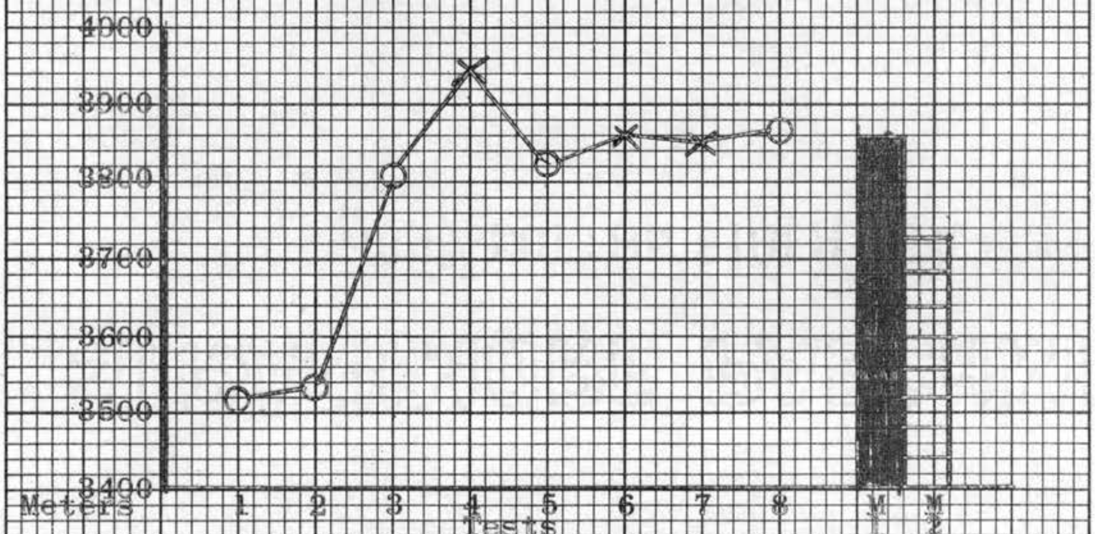

Figure 27. Distance of fifteen run

Low Weight 1=X=
High Weight 2=0=

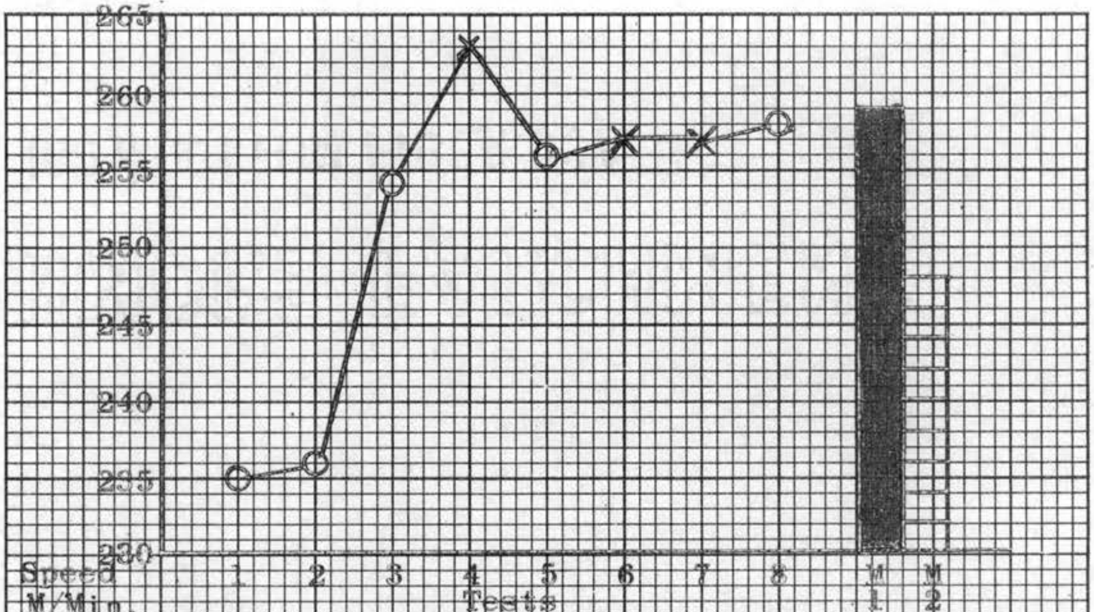

Figure 28. Speed of fifteen minute run

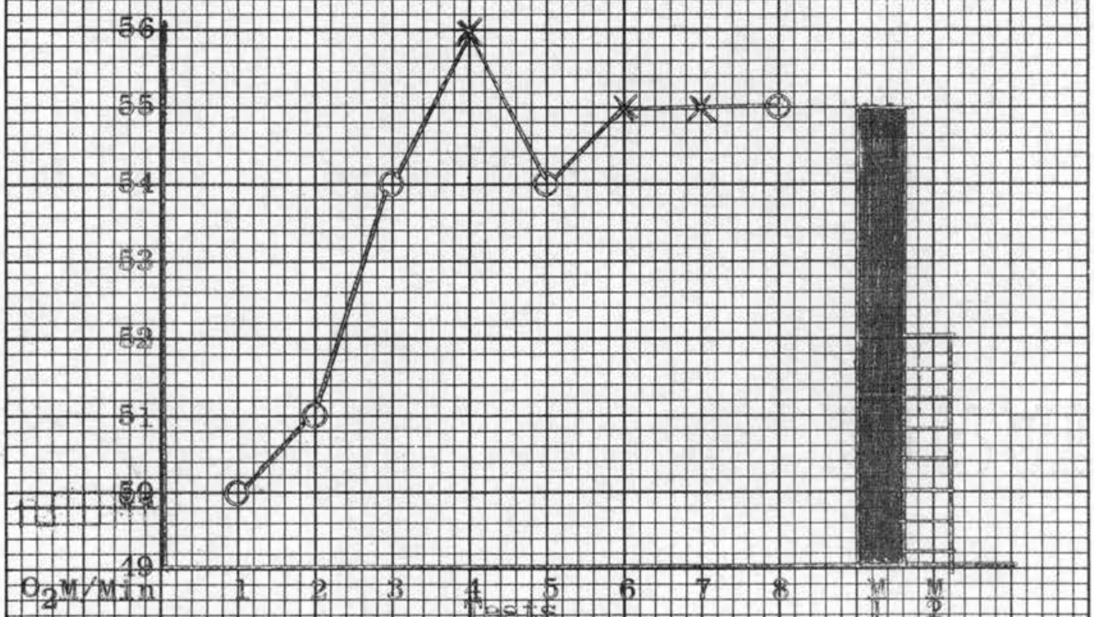

Figure 29. Estimated oxygen intake

Low Weight 1=X=
High Weight 2=0=

<u>Case Three</u>. Subject three lost 6.23 per cent of his total body weight to wrestle at his competitive weight class of 147 pounds. The tests for this subject included three low weight and three high weight days. The findings indicated that cardiovascular efficiency on low weight days was equal to or improved over high weight responses. Vital capacity residuals showed low weight scores representing better results. Predicted weight measures in both groups of responses showed skeletal measurements to predict higher weight. In this case abdominal fat measures represented greater differences than did the other two locations tested. Strength measurement were equal or comparable between low and high weight responses with the exception of high weight responses showing a higher push score. The endurance test showed higher scores for low weight days in distance, speed of run and oxygen intake per minute over high weight days. Individual responses and group means indicated that no harmful physiological measures are brought about by rapid weight loss in this subject.

Each individual test and its response is noted on Table III and plotted on Figures 30 through 43.

TABLE III

CASE THREE

Dates	Jan. 13	Jan. 20	Feb. 1	Feb. 10	Feb. 26	Mar. 13	Mean Low Weight	Mean High Weight
Weights	148	157	147	150	147	146	147	154
Resting Blood Pressure	122/70	118/80	110/78	118/74	122/80	110/80	116/77	118/77
Resting Pulse Rate	56	52	48	48	60	48	53	50
Schneider Index	18	18	20	21	17	22	19	19
Vital Capacity Residuals	4.2	-8	7.3	-2.8	7.3	9.3	7	-5.4
Predicted Weights								
Skeletal	143	144	144	142	143	142	143	143
Muscular	132	138	136	132	130	129	132	135
Fat Measurements								
Triceps	5	6	5	5	5	5	5	5
Subscapular	8	9	7	8	9	9	8.2	8.5
Abdominal	5	6	5	5	5	5	5	5.5
Strength Measures								
Right Hand	118	123	121	126	122	120	120	124.5
Left Hand	128	124	132	126	120	122	125	125
Push	170	172	170	182	184	190	178.5	177
Pull	100	106	100	104	100	100	100	105
Legs	428	428	432	426	435	436	432.7	427
Back	342	336	338	332	336	330	336.5	334

Fifteen Minute Run Dates	Jan. 12	Jan. 19	Feb. 1	Feb. 9	Feb. 25	Mar. 12		
Distance (Meters)	3697	3716	3853	3899	3963	3908	3855	3807
Speed	246	248	257	260	264	261	2545	254
Est. Oxygen Intake M/Min.	53	53.5	55	55.5	56	56.5	55	54.5

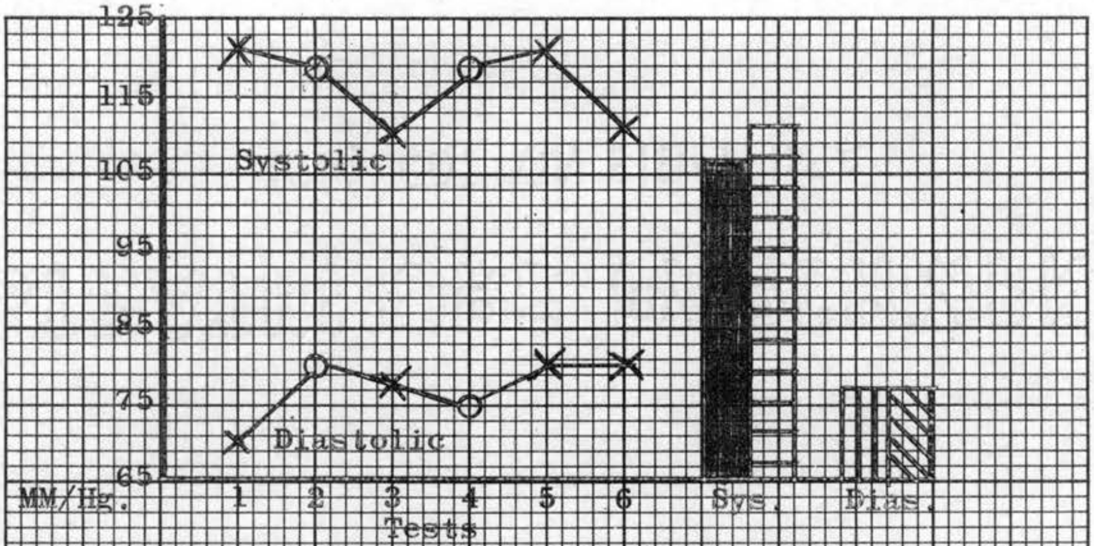

Figure 30. Resting blood pressure

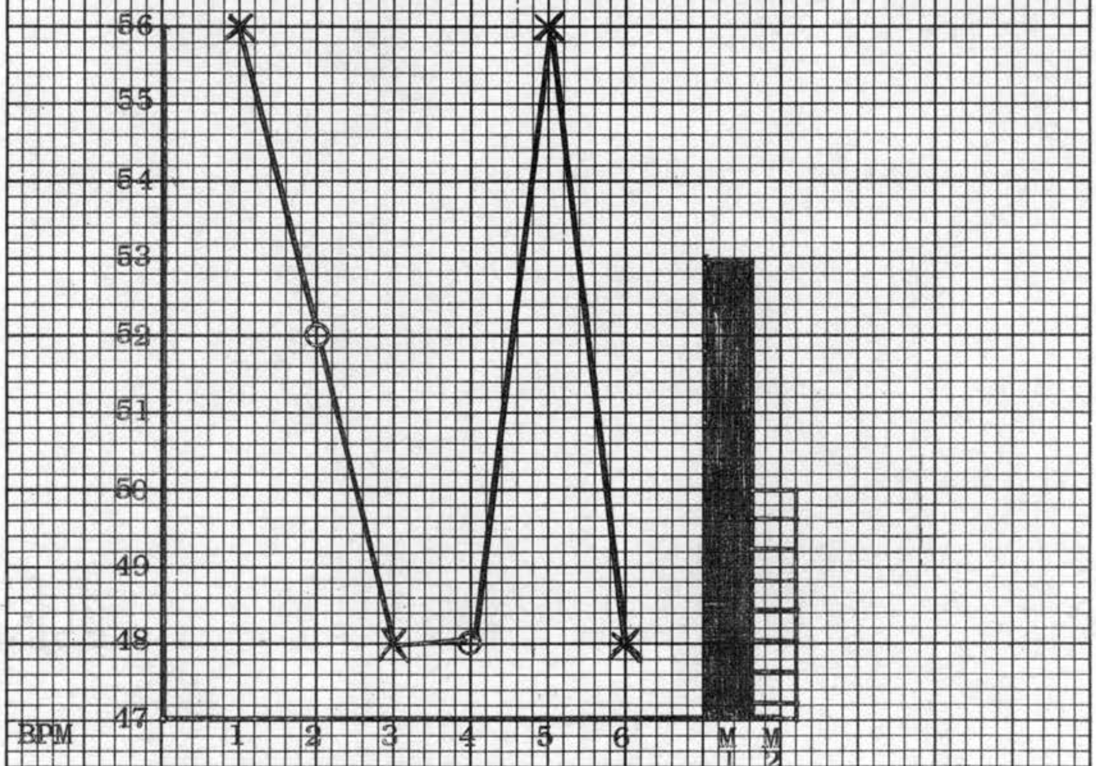

Figure 31. Resting pulse rate

Low Weight 1=X=
High Weight 2=0=

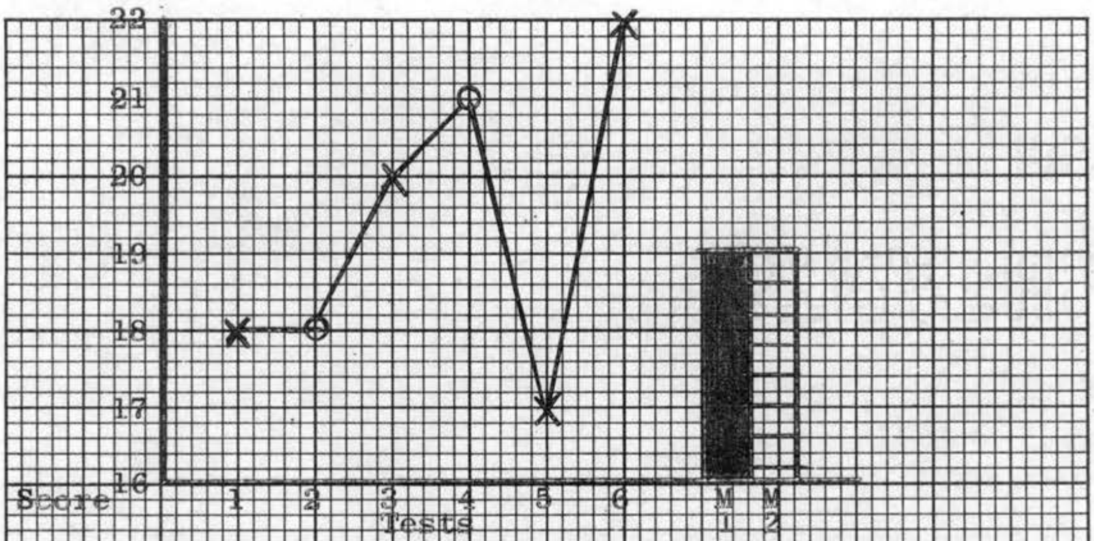

Figure 32. Schneider Index Test

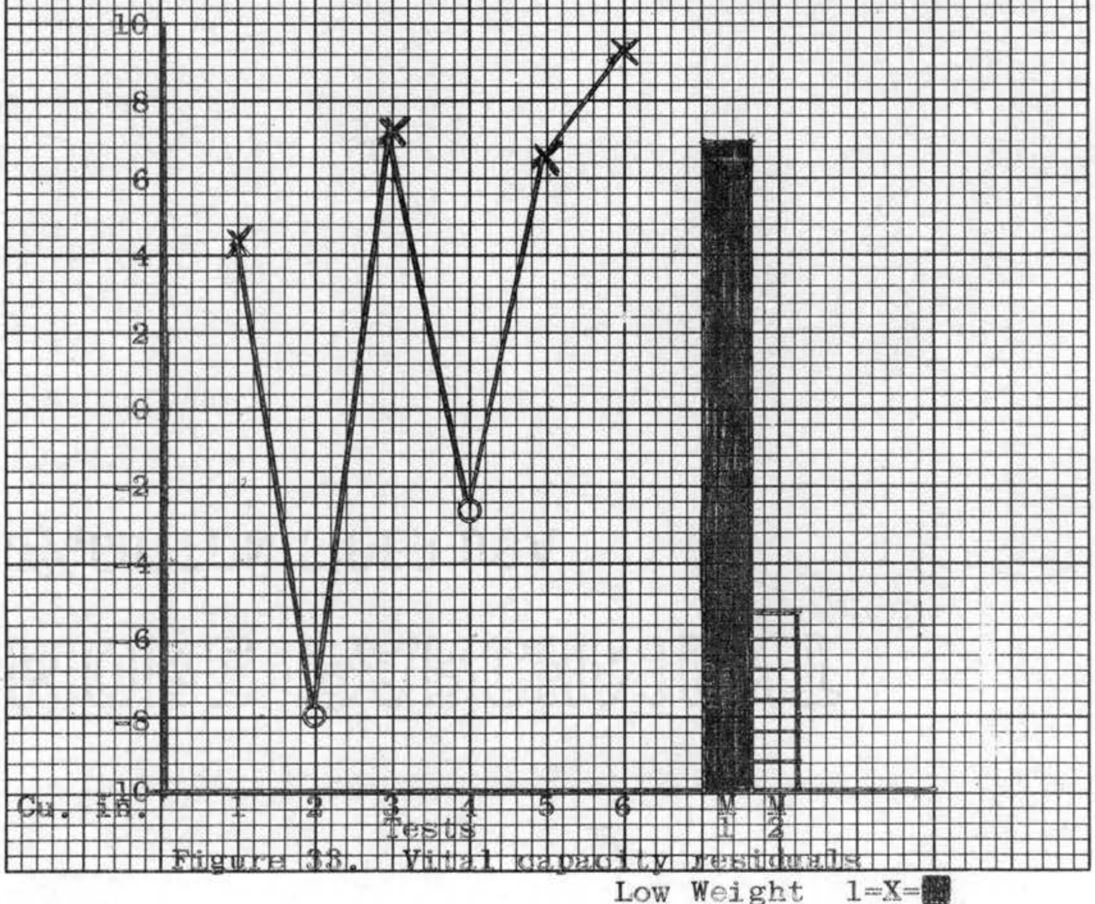

Figure 33. Vital capacity residuals

Low Weight 1=X=

High Weight 2=0=

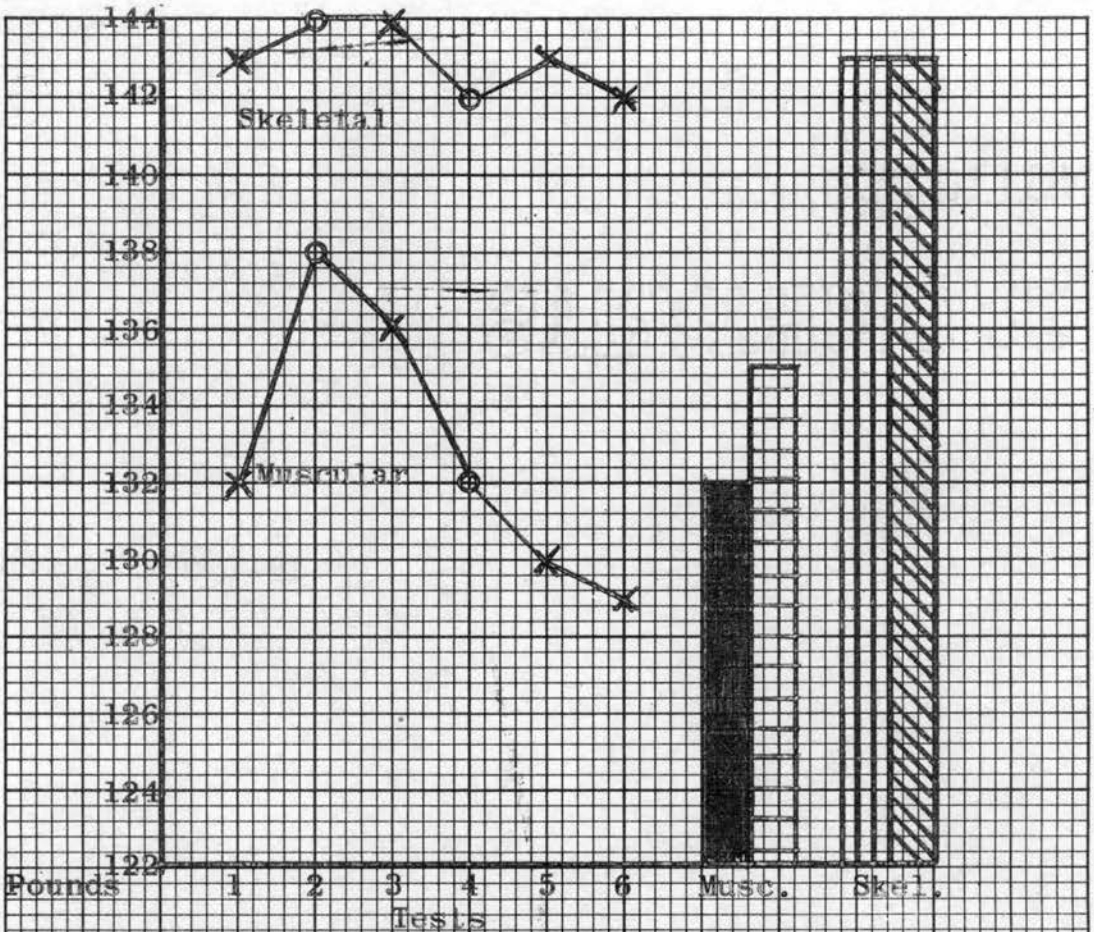

Figure 34. Predicted skeletal-muscular measures.

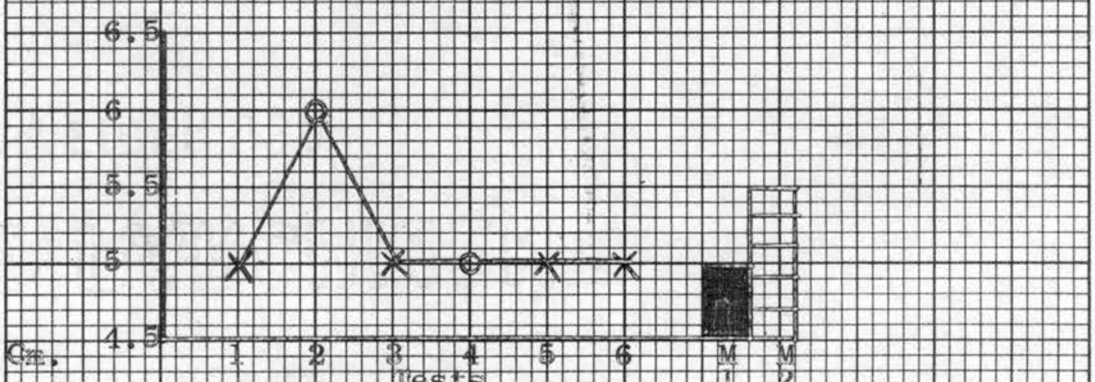

Figure 35. Triceps fat measurements

Low Weight 1=X=■ ◫
High Weight 2=0=⊟ ⧅

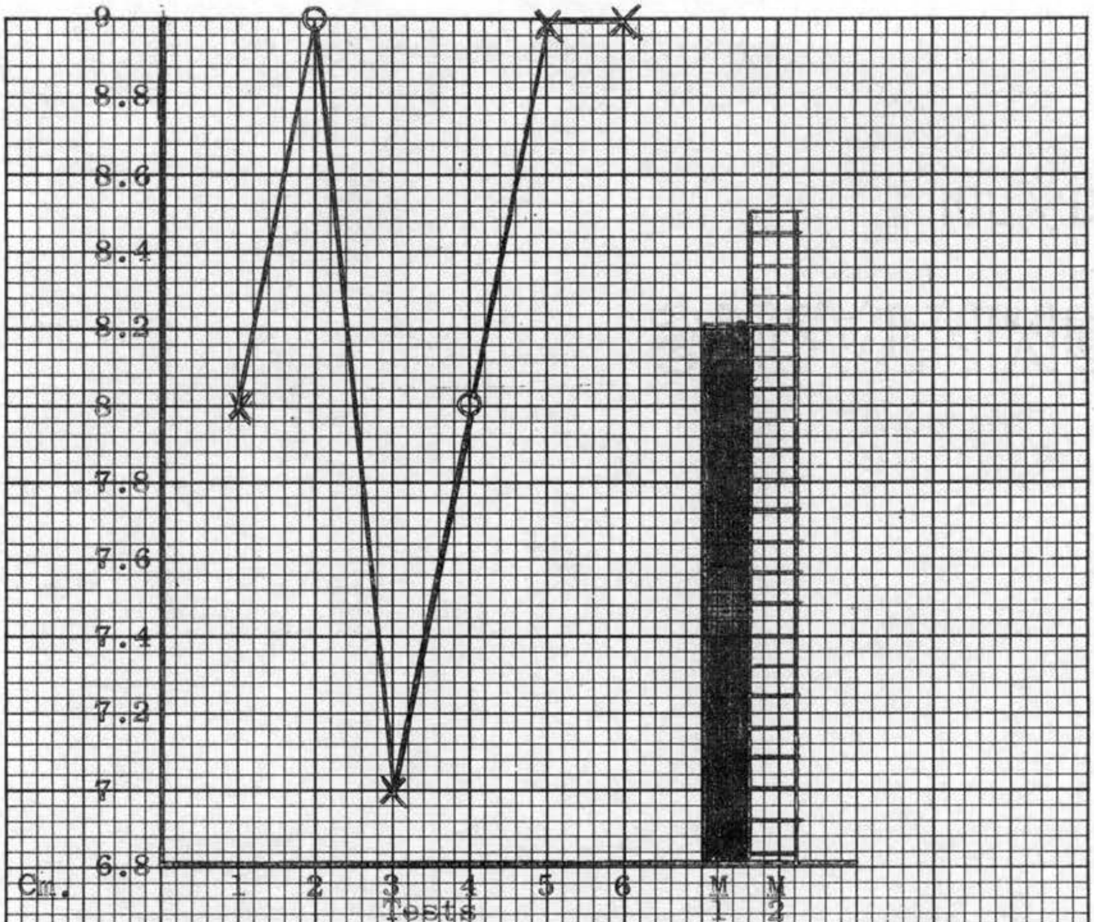

Figure 36. Subscapular fat measurements

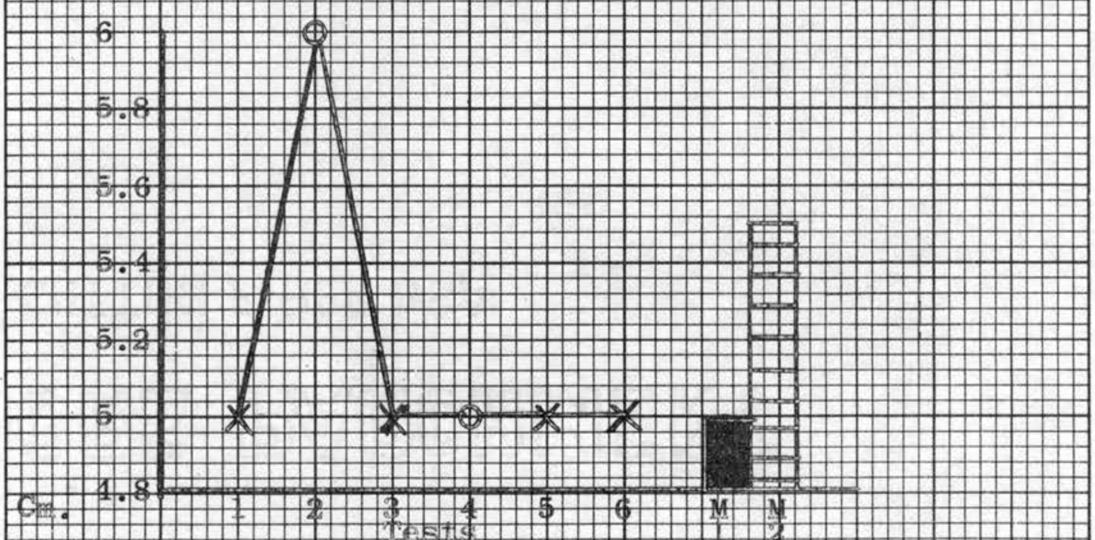

Figure 37. Abdominal fat measurements

Low Weight 1=X=■

High Weight 2=0=▤

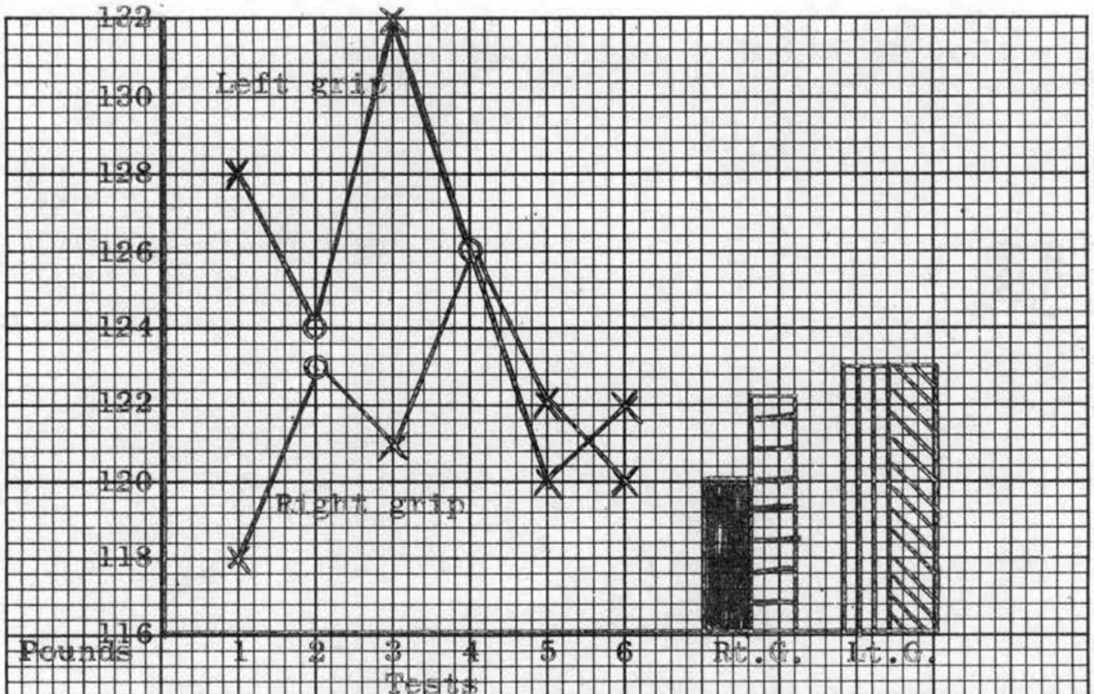

Figure 38. Grip strength measurements

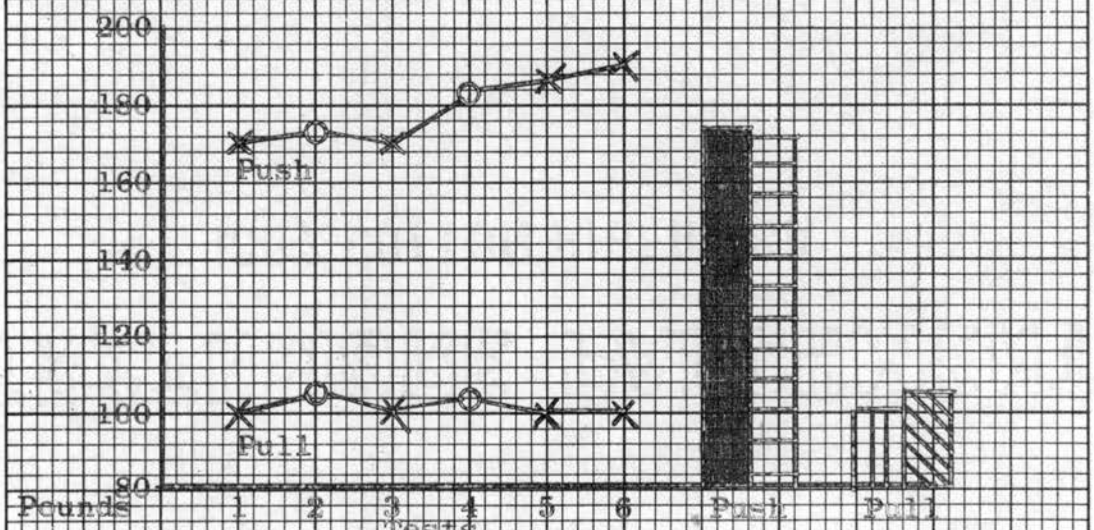

Figure 39. Push-pull strength measurements

Low Weight 1=X=
High Weight 2=0=

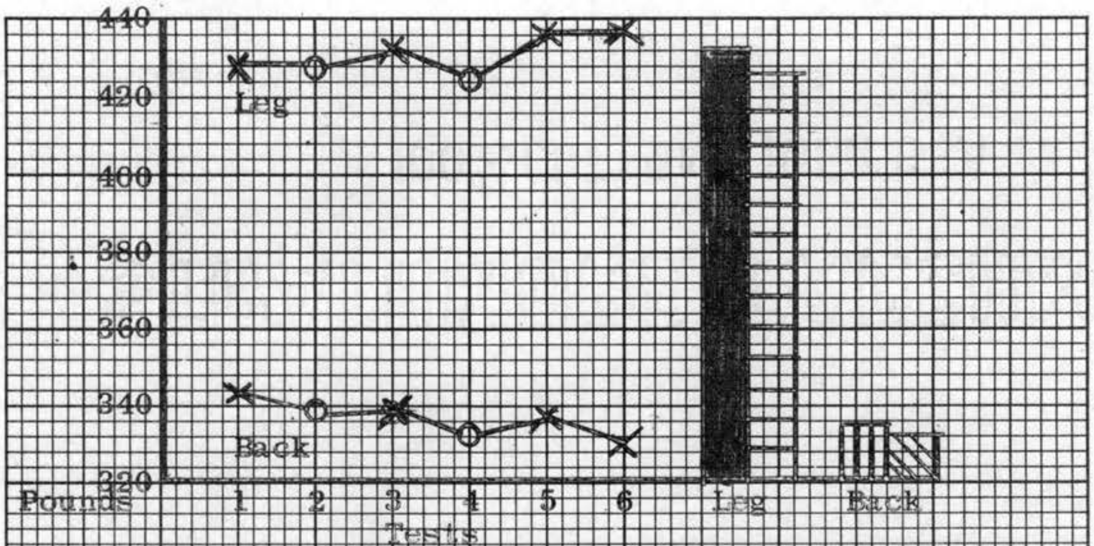

Figure 40. Leg & back strength measurements

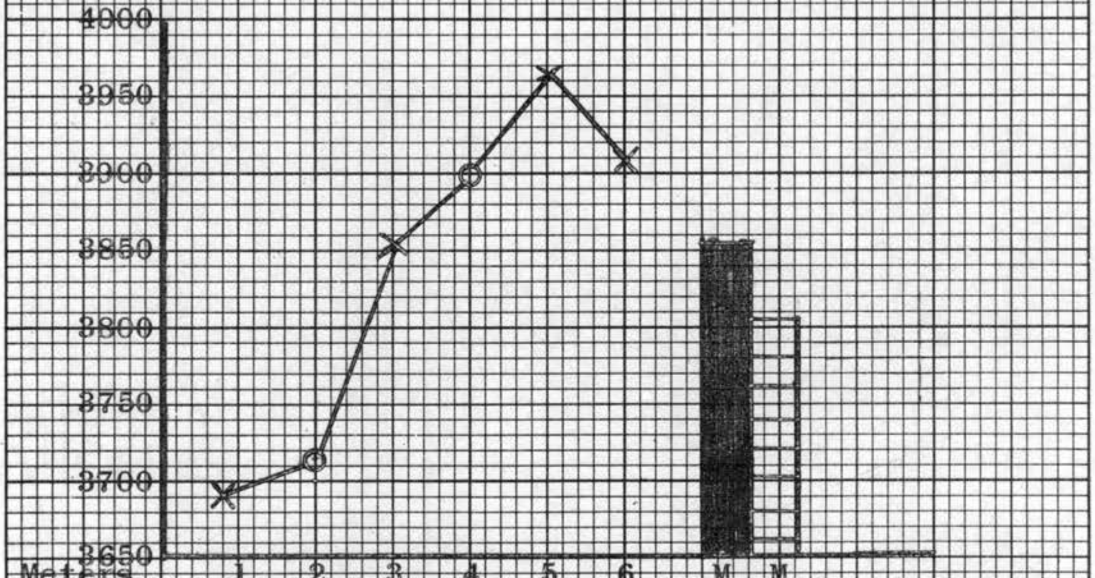

Figure 41. Distance of fifteen minute run

Low Weight 1=X=
High Weight 2=0=

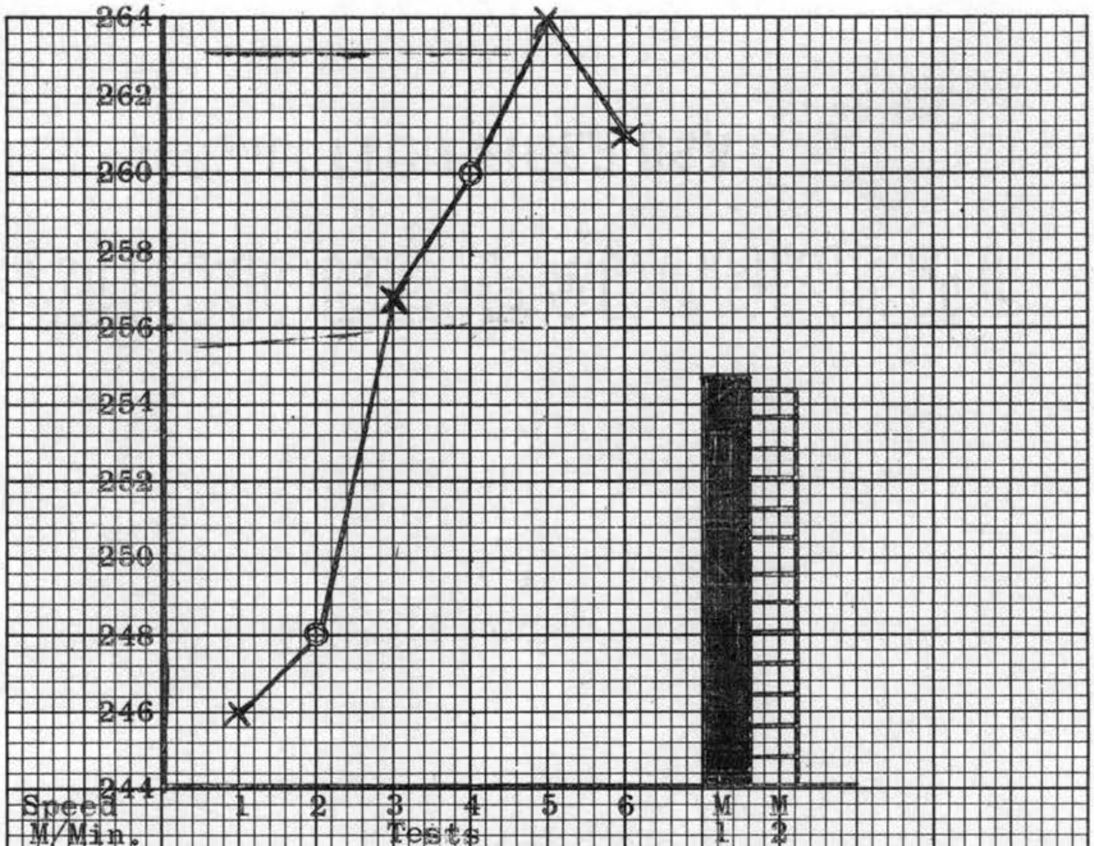

Figure 42. Speed of fifteen minute run

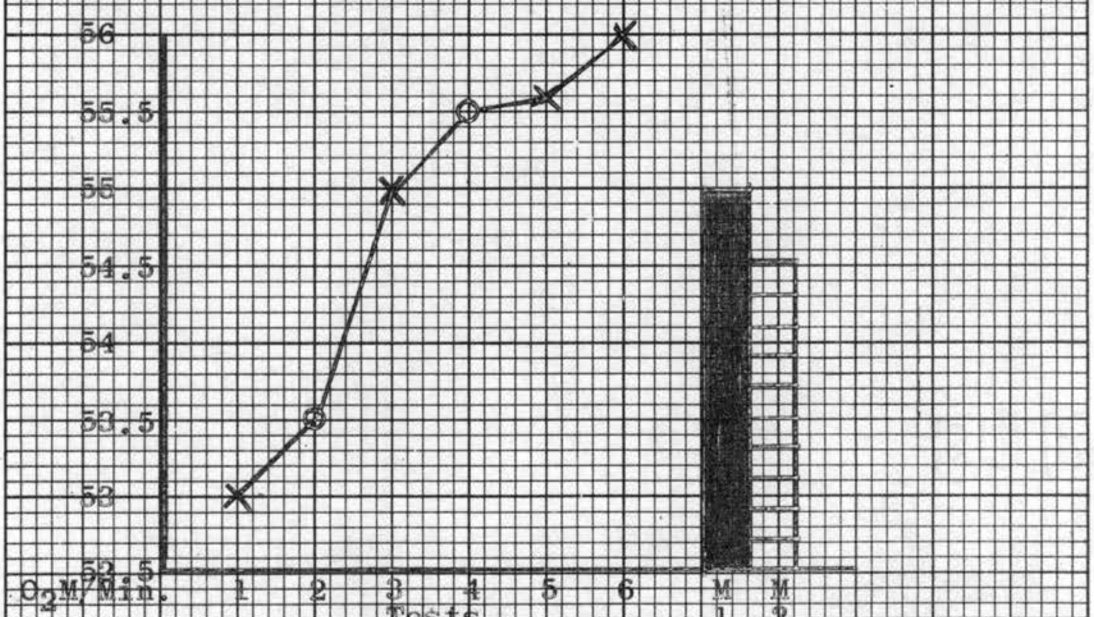

Figure 43. Estimated oxygen intake

Low Weight 1=X=■
High Weight 2=0=▤

Case Four. This athlete lost 8.08 per cent of his total body weight to compete in wrestling. Two of his five tests represented the low weight responses while the other three were on high weight days. The findings showed pulse rate responses to be ten beats per minute lower on high weight days than on low weight days. Vital capacity residuals showed a marked improvement on low weight days. The measures of both weight levels showed skeletal predicted weight to be higher than muscular measurements. The subscapular fat measurement indicated more fat lost than either of the other locations. The greatest difference between high weight and low weight responses was found in the endurance run scores. High scores in all three, distance ran, speed of run and oxygen intake occurred on low weight days. Rapid loss of weight apparently caused this subject's pulse rate to increase by about ten beats per minute. This would be considered a detrimental effect. Other than the increase in pulse rate no harmful effects were observed in this subject.

Each individual test and its response is noted on Table IV and plotted on Figures 44 through 57.

TABLE IV

CASE FOUR

Dates	Jan. 13	Feb. 2	Feb. 13	Mar. 2	Mar. 5	Mean Low Weight	Mean High Weight
Weights	139	137	130	130	143		
Resting Blood Pressure	110/60	112/66	110/70	116/80	115/70	113/75	112/65
Resting Pulse Rate	44	48	52	44	52	48	48
Schneider Index	21	19	19	22	22	21	20
Vital Capacity Residuals	34	17	24	39	13	31.5	21
Predicted Weights							
Skeletal	131.69	131.3	129	128.6	131	129	131
Muscular	132.8	131	127	125	124.7	126	129
Fat Measurements							
Triceps	6	5	4	4	5	4	5
Subscapular	9	8	5	5	7	5	8
Abdominal	6	9	6	6	10	6	8
Strength Measurements							
Right Hand	85	90	94	98	86	96	87
Left Hand	100	115	125	106	102	115	106
Push	140	136	120	122	140	121	138
Pull	90	86	80	80	80	80	85
Legs	330	302	296	267	279	281	303
Back	279	280	276	294	279	283	279

Fifteen Minute Run Dates	Jan. 12	Feb. 1	Feb. 13	Mar. 1	Mar. 4		
Distance (Meters)	3697	3779	3798	3863	3467	3831	3647
Speed	246	252	253	257	231	255	243
Est. Oxygen Intake M/Min.	41	24	27	53	17	40	28

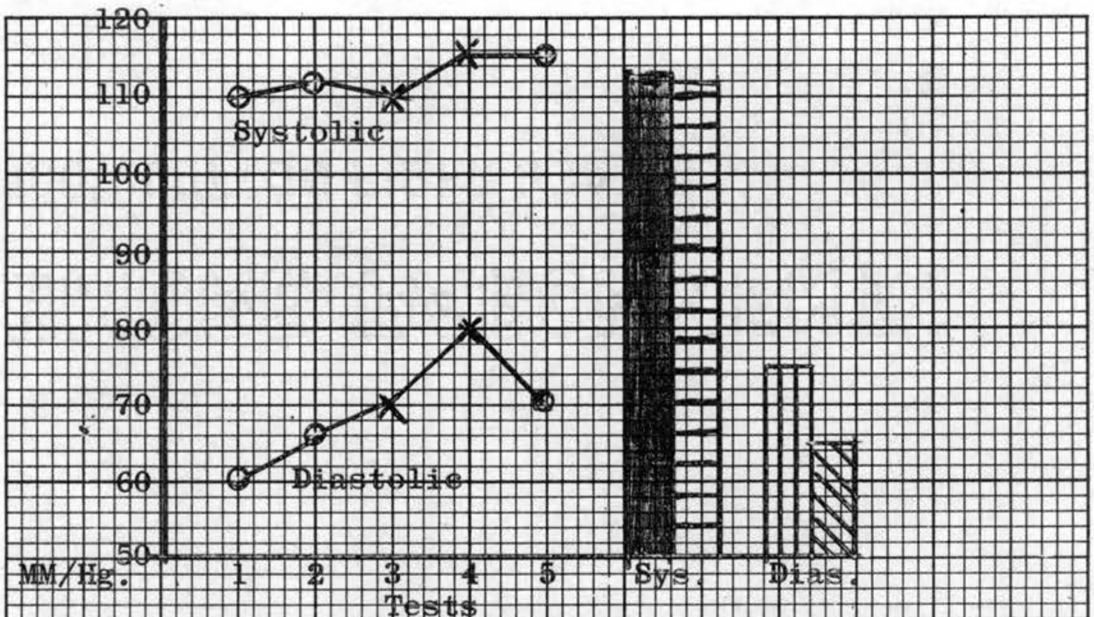

Figure 44. Resting blood pressure

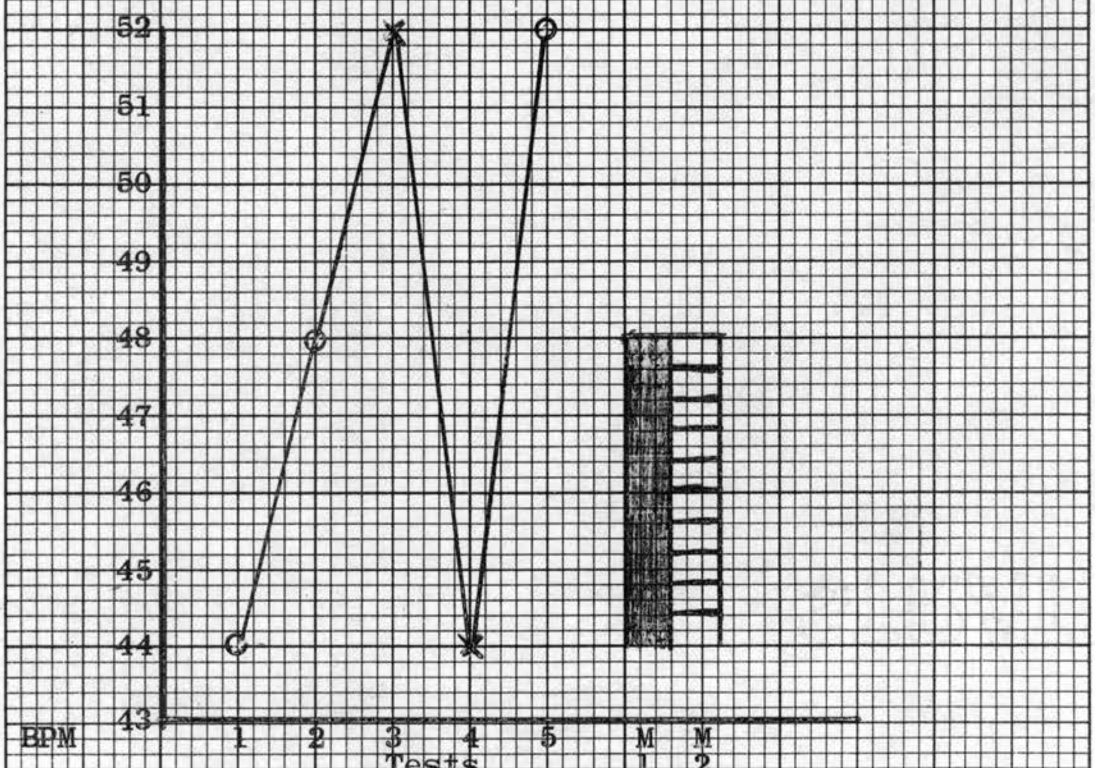

Figure 45. Resting pulse rate

Low Weight 1=X=

High Weight 2=0=

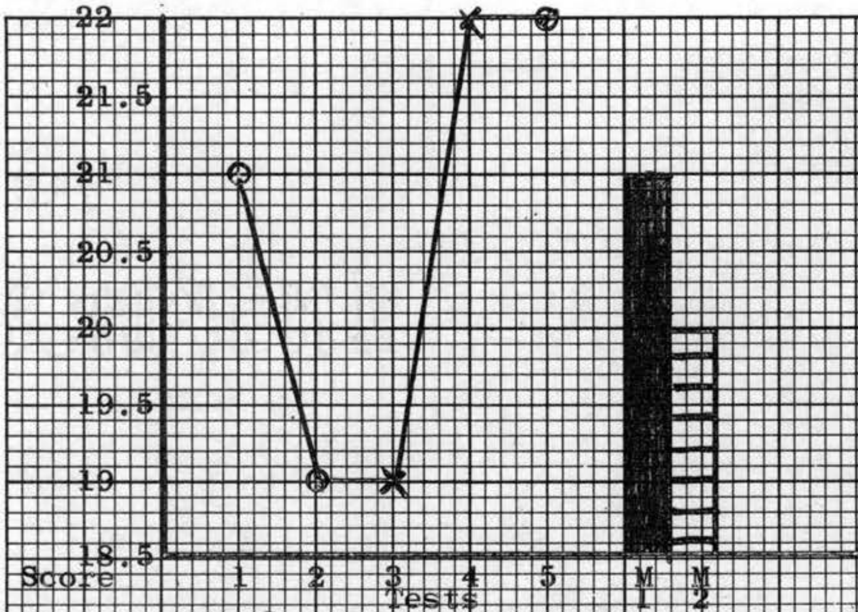

Figure 46. Schneider Index Test

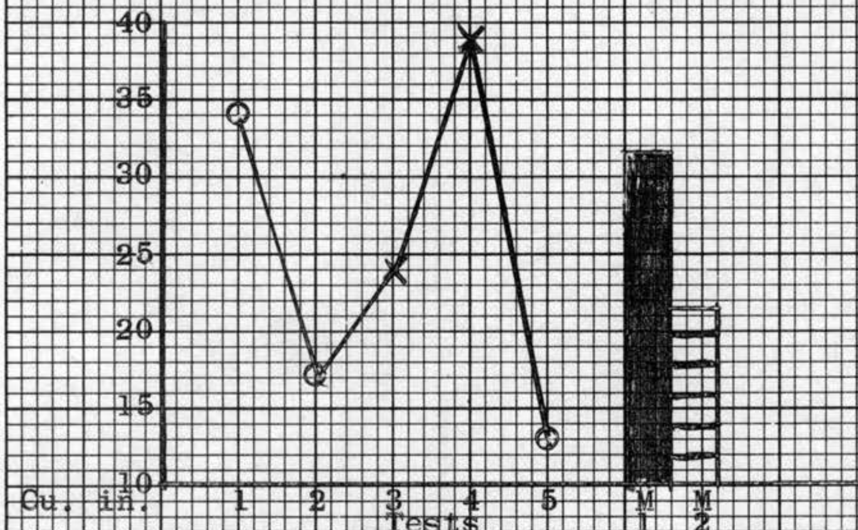

Figure 47. Vital capacity residuals

Low Weight 1=X=
High Weight 2=0=

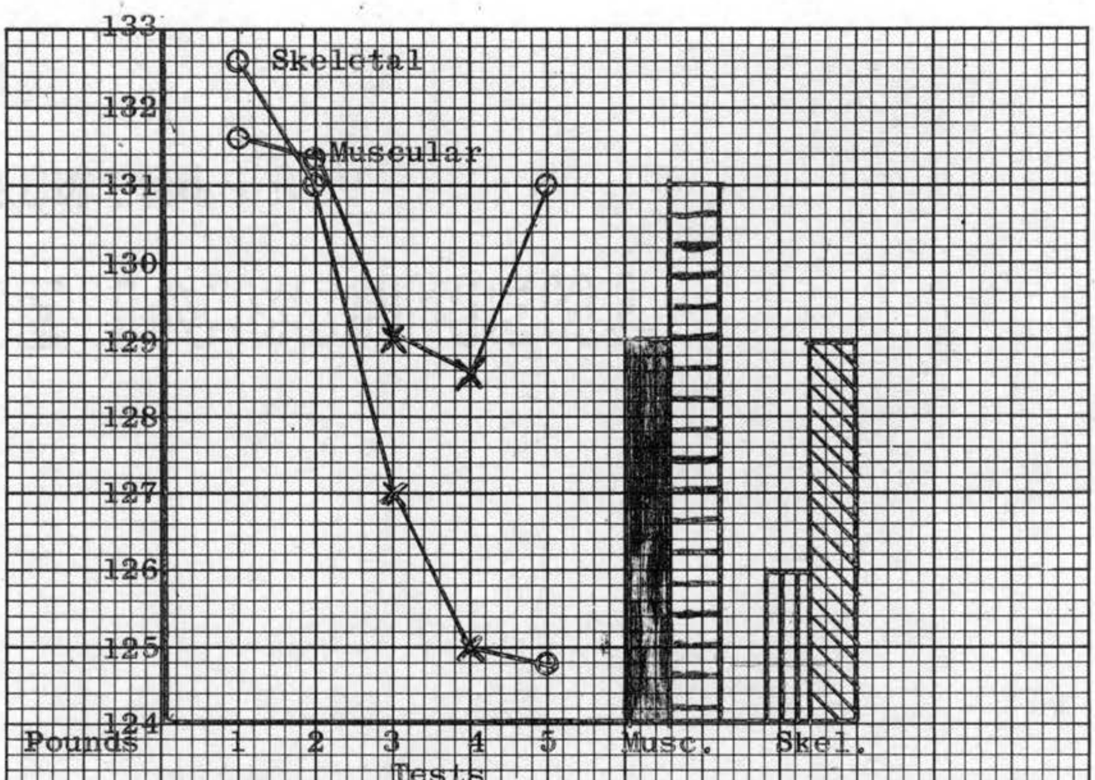

Figure 48. Predicted skeletal-muscular measures

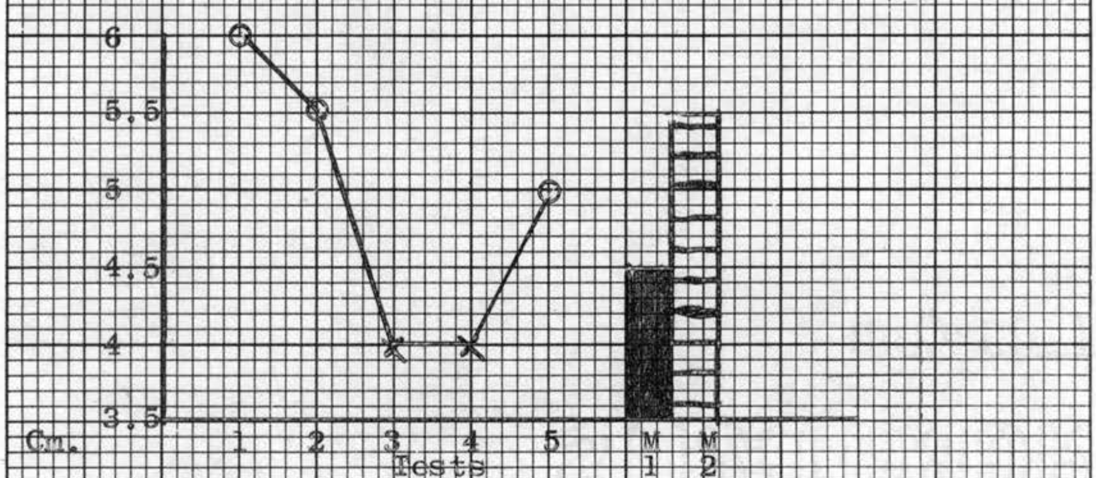

Figure 49. Triceps fat measurements

Low Weight 1=X=■ ▯
High Weight 2=0=▤ ▧

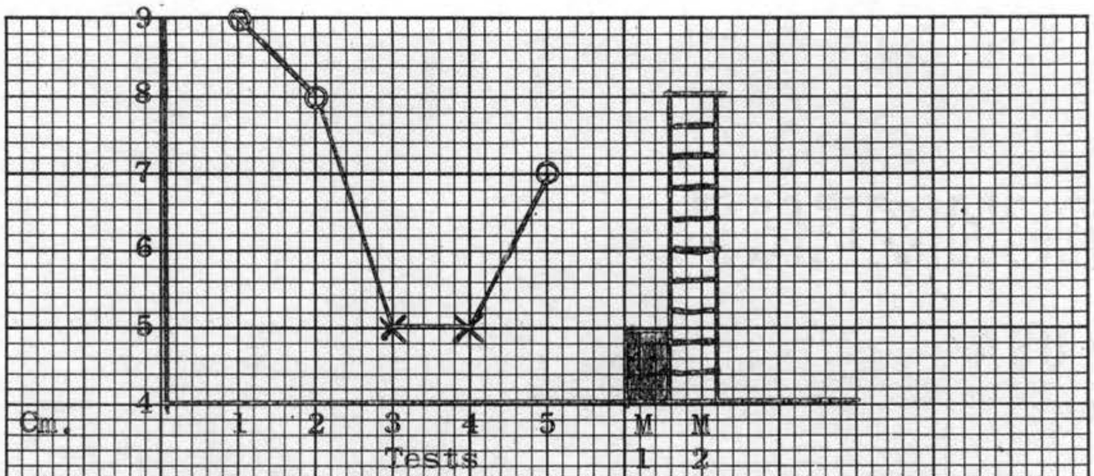

Figure 50. Subscapular fat measurements

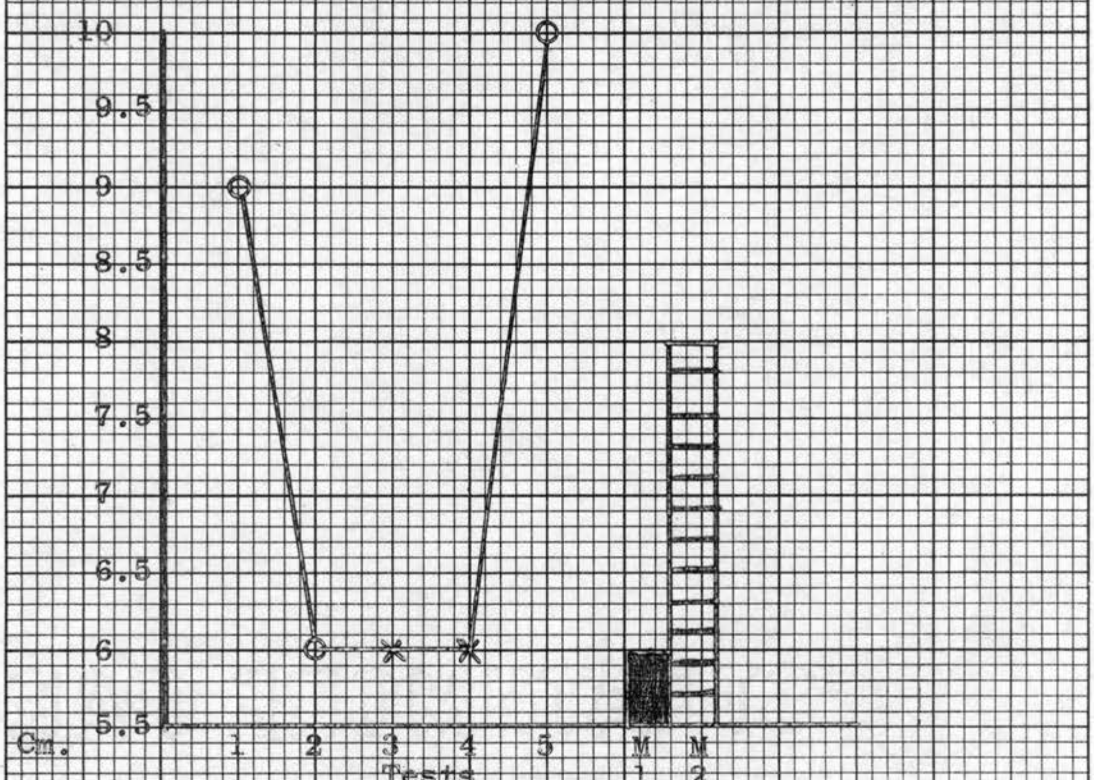

Figure 51. Abdominal fat measurements

Low Weight 1=X=■
High Weight 2=0=▤

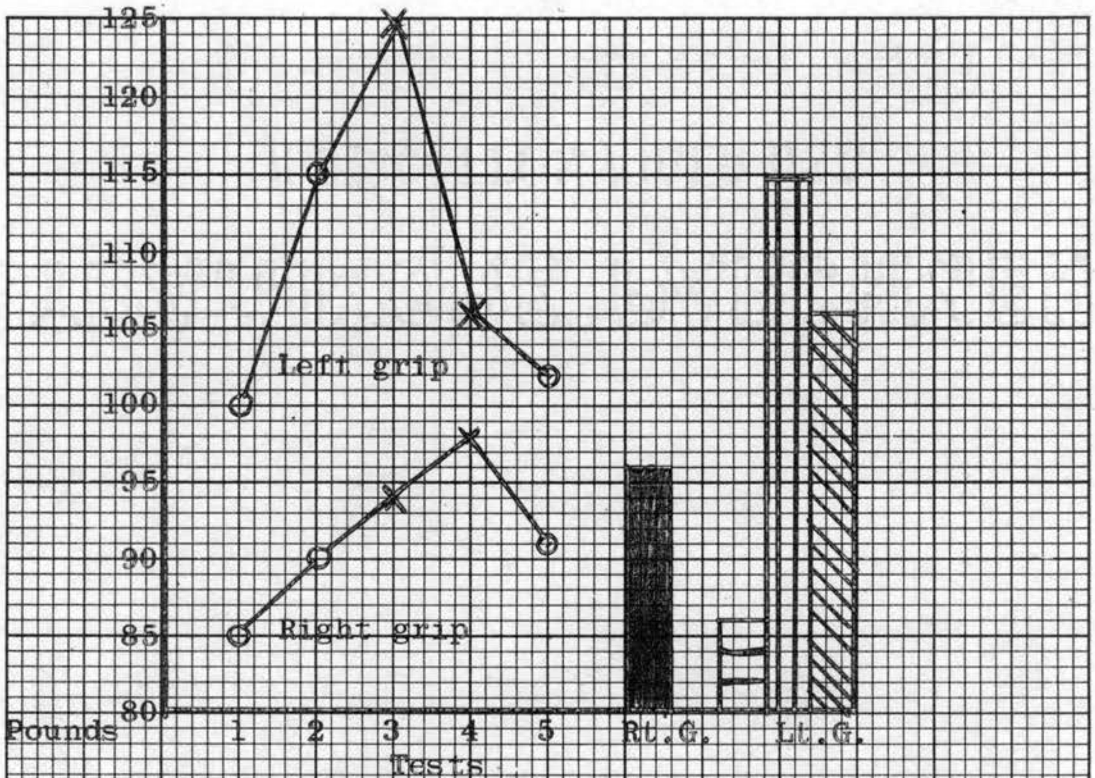

Figure 52. Grip strength measurements

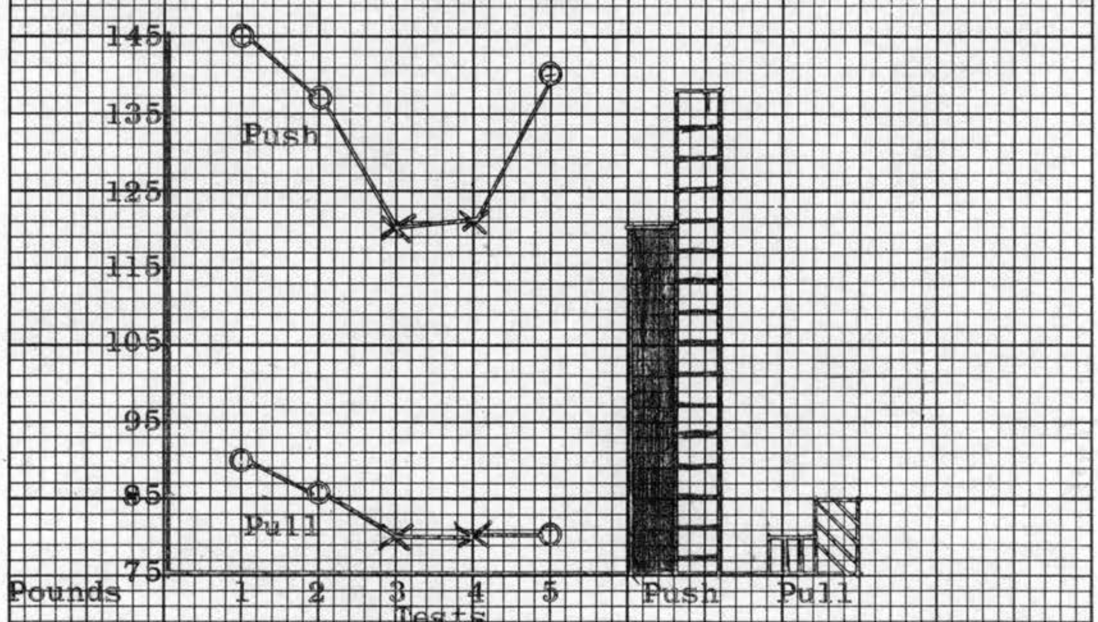

Figure 53. Push-pull strength measurements

Low Weight 1=X=
High Weight 2=0=

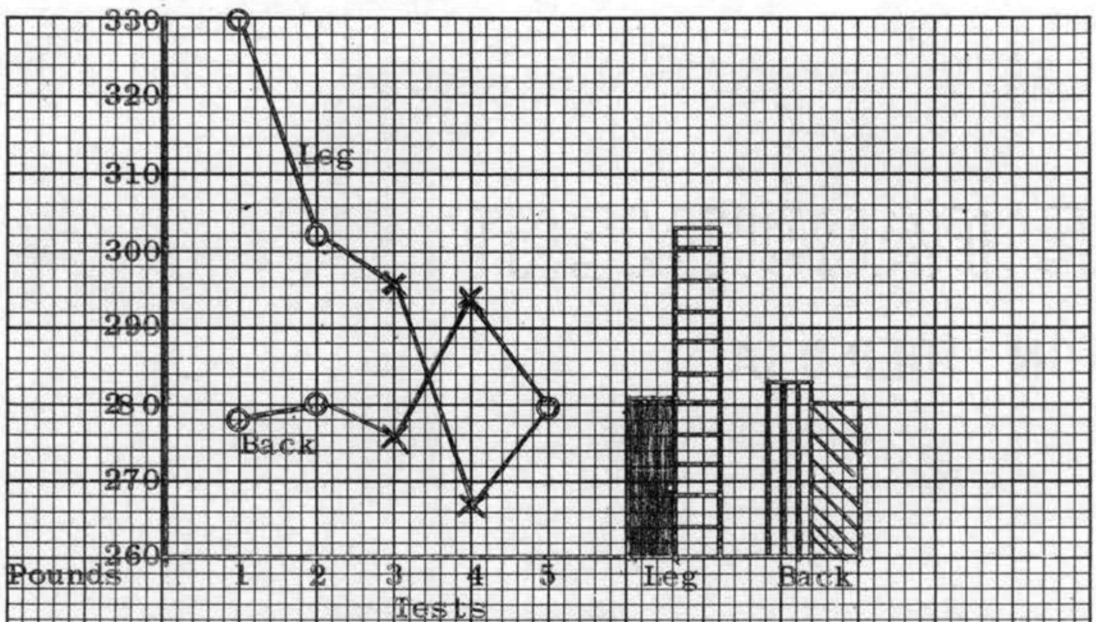

Figure 54. Leg & back strength measurements

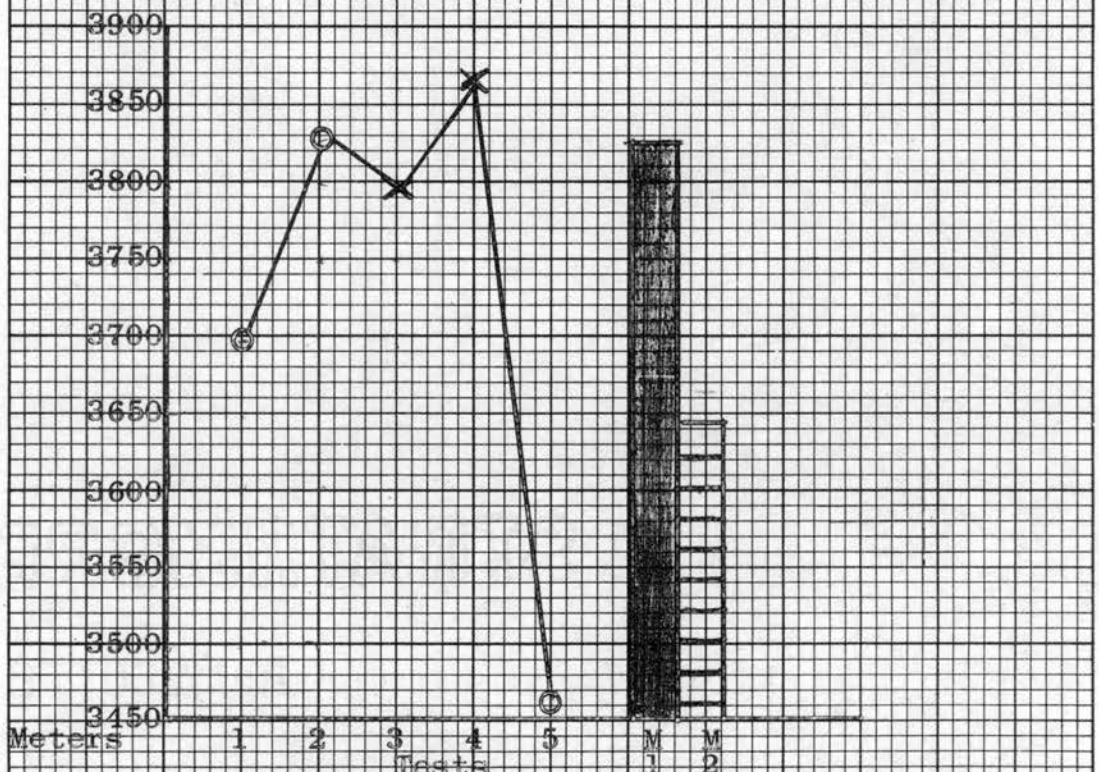

Figure 55. Distance of fifteen minute run

Low Weight 1=X=
High Weight 2=0=

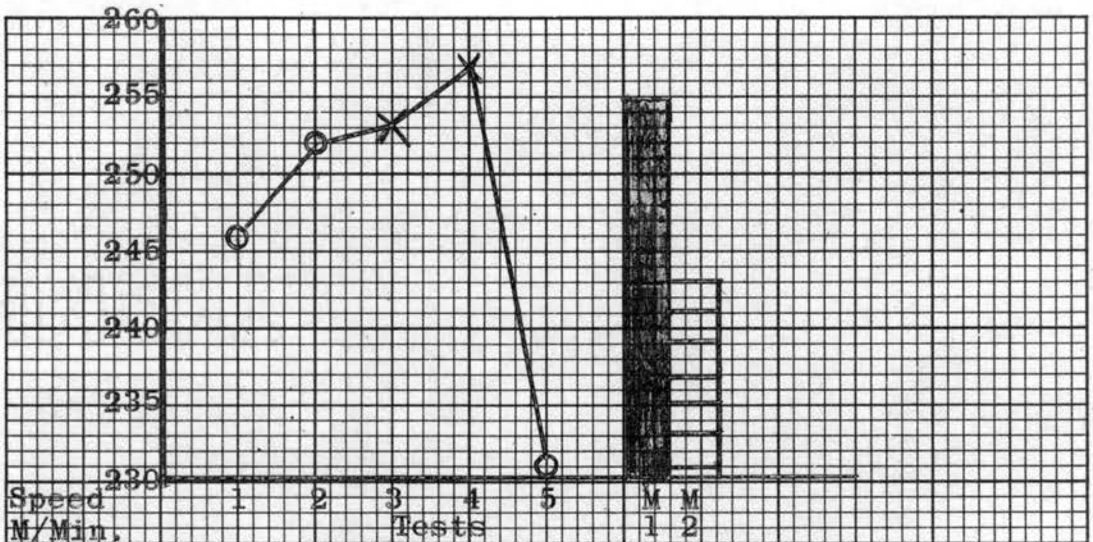

Figure 56. Speed of fifteen minute run

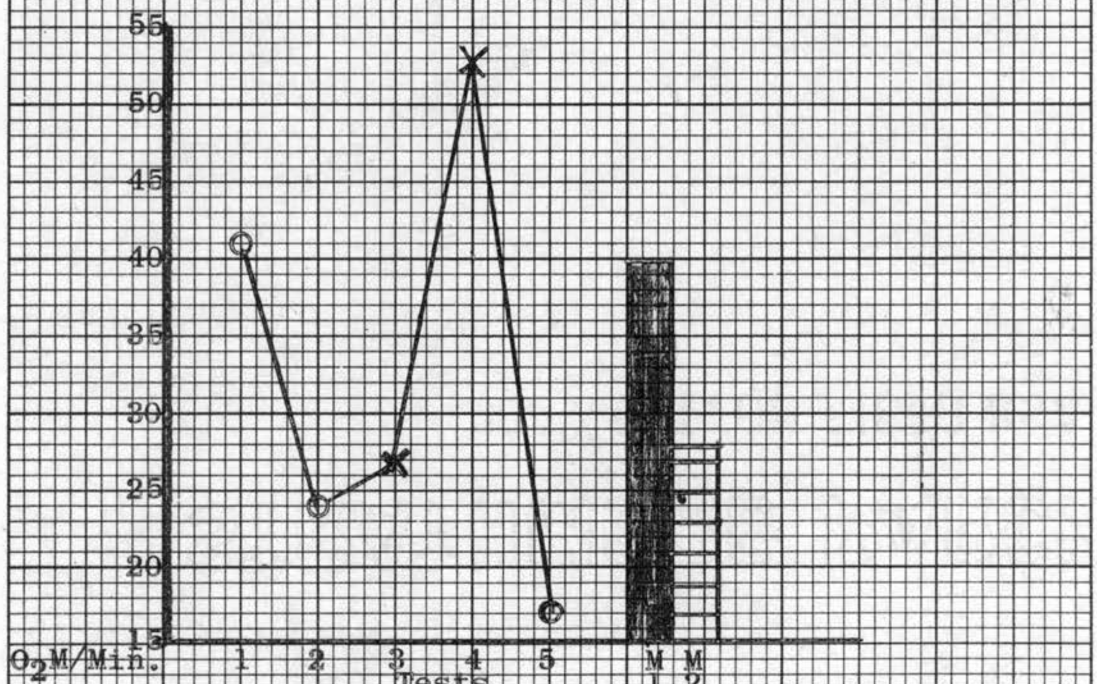

Figure 57. Estimated oxygen intake

Low Weight 1=X=

High Weight 2=0=

Mean Scores. The average weight loss experienced by the four subjects of this study is 8.57 per cent of their total body weight. Of the three measures tested by cardiovascular efficiency tests, none showed any harmful effects due to rapid loss of weight. A mean increase of eleven cubic inches was found in low weight responses of vital capacity residuals. Low and high weight days in all cases indicated skeletal measurements for predicting weight to be higher and most consistent. The highest difference in group means showed that subscapular fat measurements represented largest variation between tests on low weight days and those of high weight days. The slight differences in strength scores were not great enough to imply any harmful effects of weight loss. The endurance run of fifteen minutes showed higher mean scores for distance ran, speed of run and estimated oxygen intake on low weight days than mean scores on high weight days. The comparison of physiological tests included in this experiment indicated that rapid weight loss had no harmful effect upon these wrestlers. Of all the physiological tests used the vital capacity residuals and the three components of the fifteen minutes run showed consistent differences between the two groups. The low weight days responses showed marked higher scores in all of these tests.

Each mean score and its response are plotted on Figures 58 through 71.

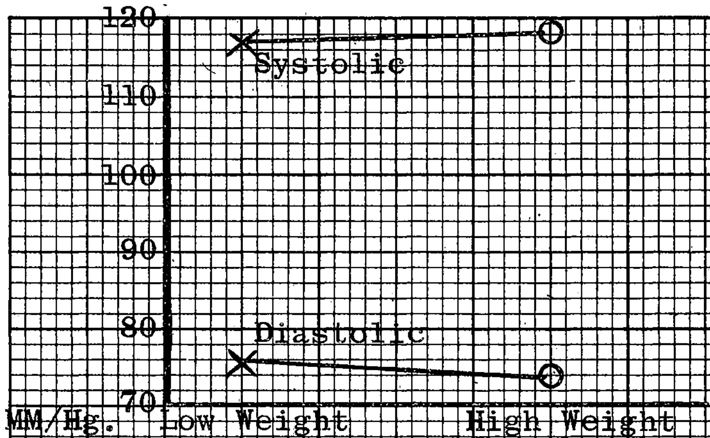

Figure 58. Mean resting blood pressure

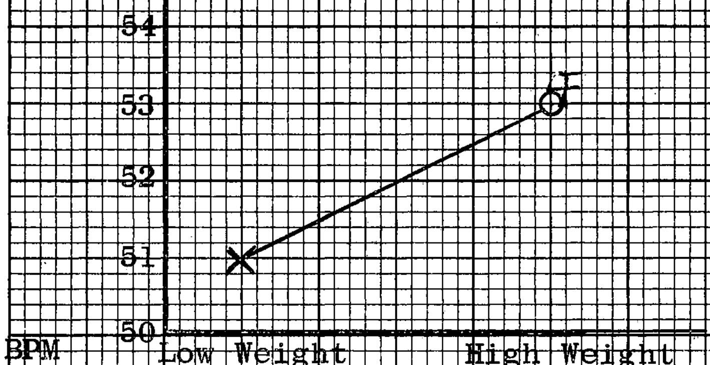

Figure 59. Mean resting pulse rate

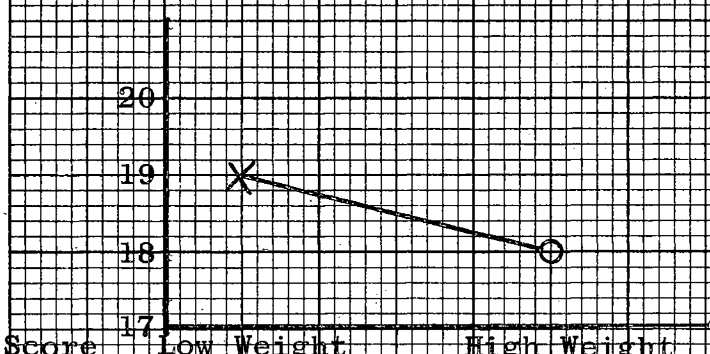

Figure 60. Mean Schneider Index Test

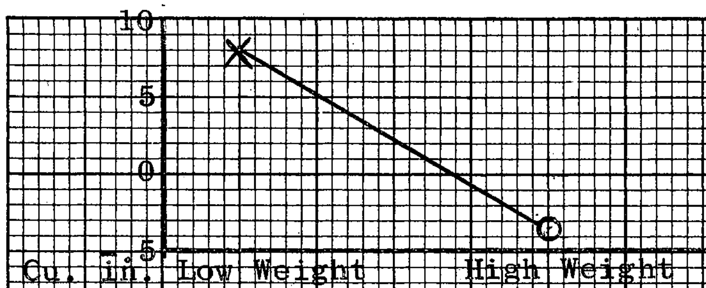

Figure 61. Mean vital capacity residuals

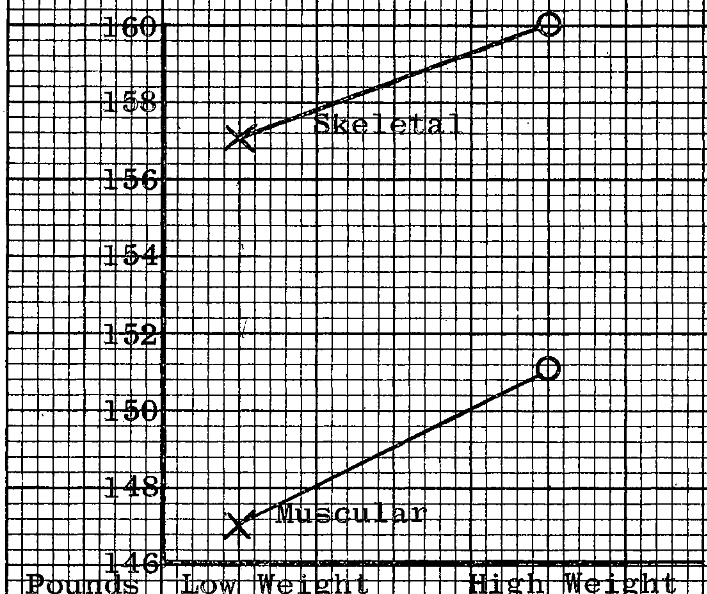

Figure 62. Mean skeletal-muscular measures

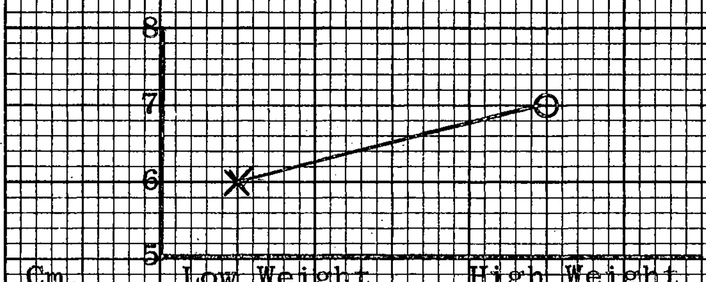

Figure 63. Mean triceps fat measurement

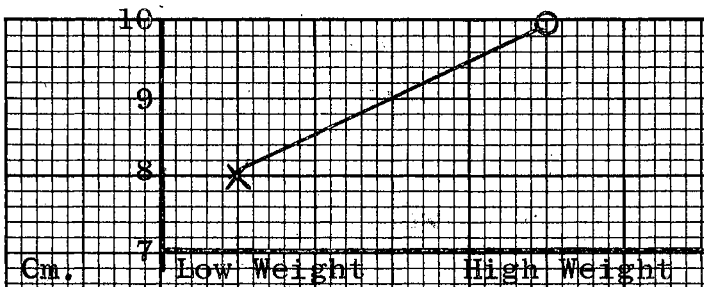

Figure 64. Mean subscapular fat measurements.

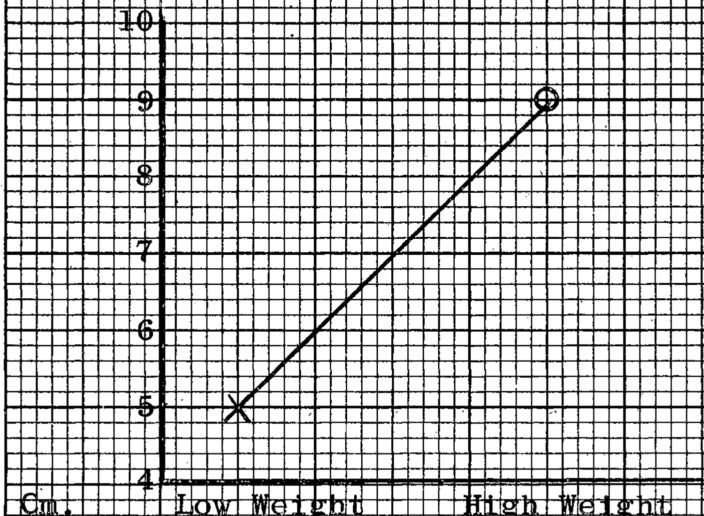

Figure 65. Mean abdominal fat measurements

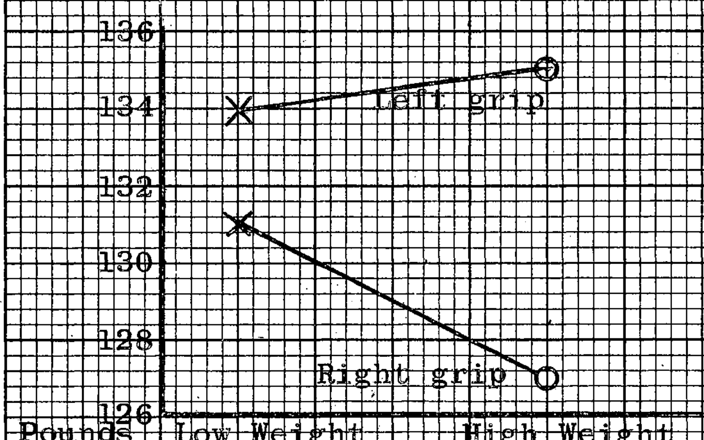

Figure 66. Mean grip strength measurements

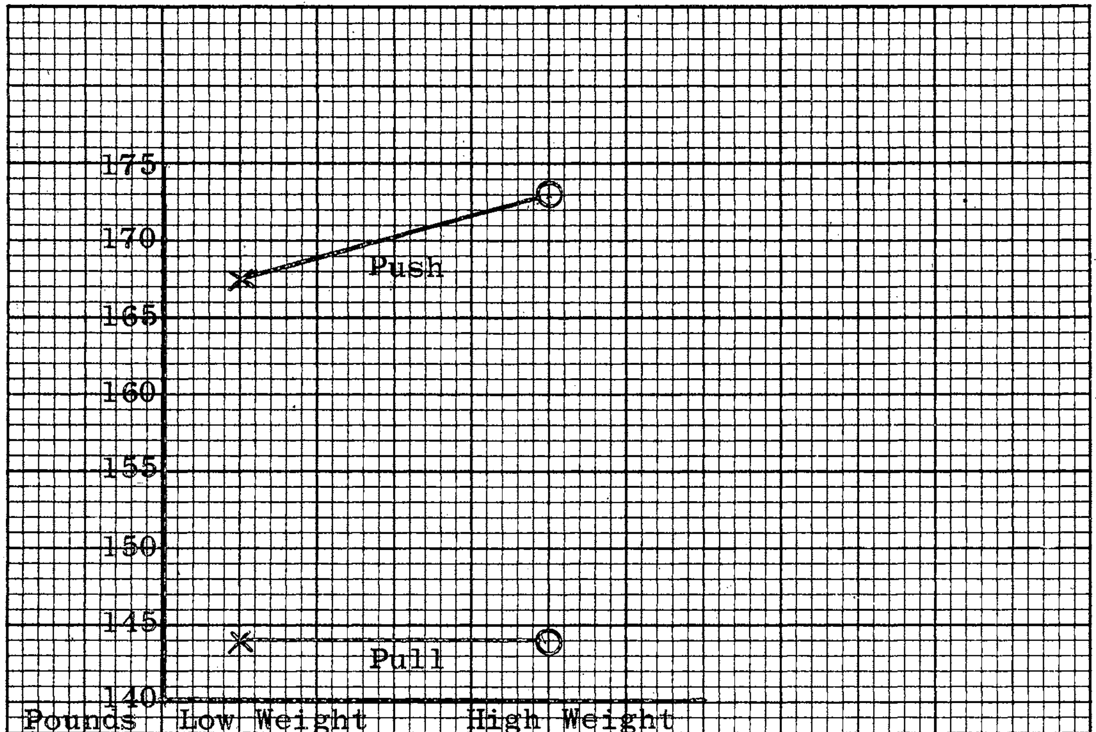

Figure 67. Mean push-pull strength measurements

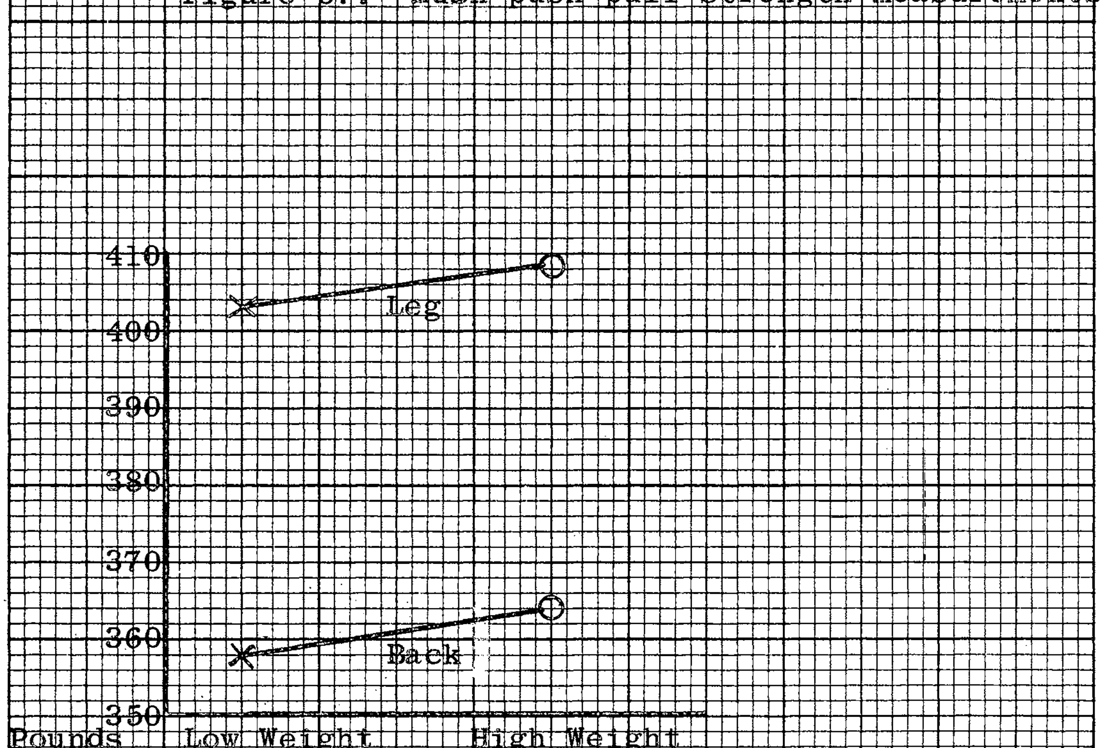

Figure 68. Mean leg & back strength measurements

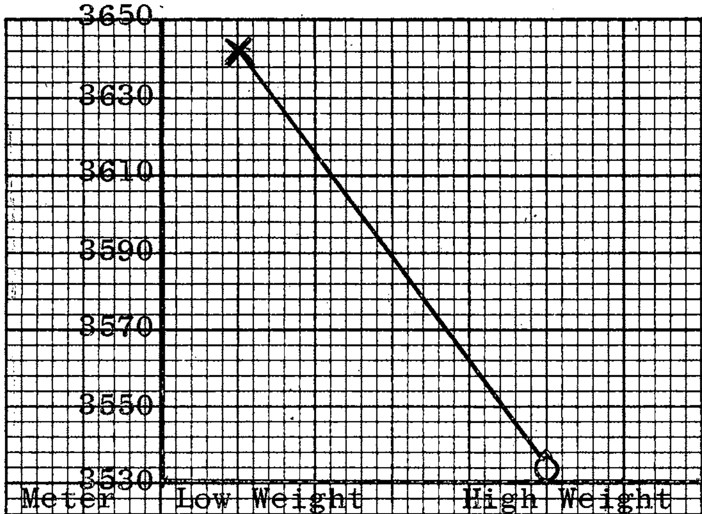

Figure 69. Mean distances of fifteen minute run

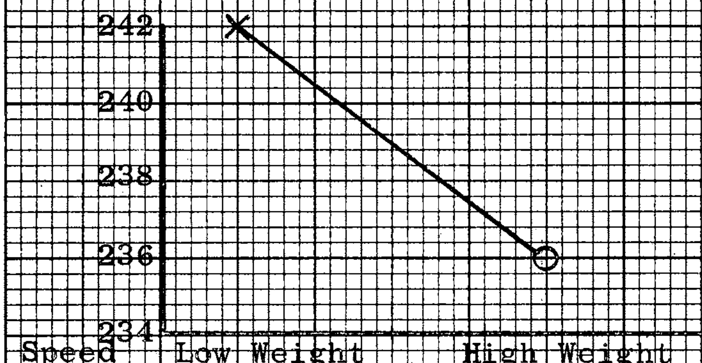

Figure 70. Mean speed of fifteen minute run

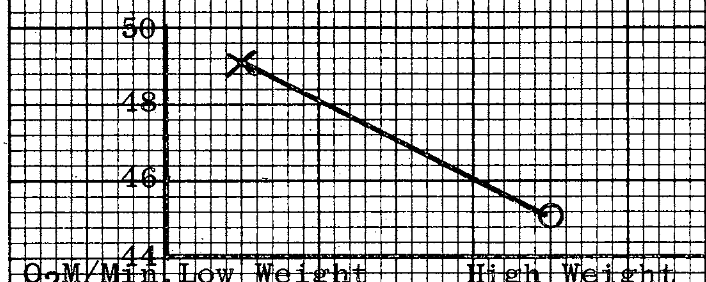

Figure 71. Mean estimated oxygen intake

CHAPTER V

Conclusion

On the basis of this experiment it has been shown that rapid weight loss had no effect on the physiological responses of these four wrestlers who lost an average of 8.57 per cent of their body weight.

The findings of this experiment justify the following conclusions in regard to these four subjects.

1. Weight loss did not materially affect the scores of the cardiovascular efficiency tests.

2. Vital capacity residuals increased eleven cubic inches on low weight days in comparison to high weight days.

3. The Skinfold fat measures were lower on low weight days than on high weight days with the subscapular location showing the greatest loss in fat.

4. Weight loss did not have any detrimental effects on these wrestlers' strength.

Endurance as tested by means of the fifteen minute run showed a marked improvement on low weight days. The low weight scores were greater in distance ran, speed of run and estimated oxygen intake for all cases.

This study indicated that these wrestlers safely lost weight up to 8.57 per cent of their body weight without adversely affecting the physiologic responses measured in this experiment.

SELECTED BIBLIOGRAPHY

Ahlman, K. and Karvonen, J.J. "Weight Reduction by Sweating in Wrestlers, and Its Effect on Physical Fitness." The Journal of Sport Medicine and Physical Fitness, I (September 1961), pp. 23-26.

Asher, D.W. and Hodes, H.L. "Studies in Experimental Dehydration." American Journal of Technology, V (November 1939), pp. 316-334.

Balke, B. "A Simple Field Test for the Assessment of Physical Fitness." Oklahoma City: Civil Aeromedical Research Institute, 1963. 8pp.

Byram, H.M. "Effects of Weight Reduction on Strength and on Muscular Endurance." Unpublished Master's thesis, State University of Iowa, Iowa City, 1953. 12 pp.

Cureton, T.K. Physical Fitness Appraisal and Guidance. St. Louis: C.V. Mosby Company, 1947. 566 pp.

______. Physical Fitness Workbook. St. Louis: C.V. Mosby, 1947. 150 pp.

Dawson, P.M. "Effect of Physical Training and Practice on the Pulse Rate and Blood Pressure During Activity and During Rest, with a Note on Certain Acute Infections and on the Distress Resulting from Exercise." American Journal of Physiology (1919), 50:433.

Doscher, Nathan. "The Effect of Rapid Weight Loss Upon the Performance of Wrestlers and Boxers, and Upon the Physical Proficiency of College Students." Research Quarterly, XV (December 1944), pp. 317-324.

Edwards, Jennings B. "A Study of the Effect of Semi-starvation and Dehydration on Strength and Endurance with Reference to College Wrestling." Unpublished Master's thesis, University of North Carolina, Chapel Hill, 1951. 42 pp.

Gillum, O.C. "The Effects of Weight Reduction on the Bodily Strength of Wrestlers." Unpublished Master's thesis, Ohio State University, Columbus, 1940. 59 pp.

Gullichsen, R. and Soisalon - Soininen, J.G. "Uber die Kohlenstoffabgabe des Menshen beim Fechten und Ringer." Skandinav. Arch. F. Physiology (1921), 41:188.

Heintz, Mary. "Device for Testing Back Strength." Research Quarterly, XXXIII (December 1962), p. 638.

Hunt, J. A Conquest of Everest. New York: E.P. Dutton and Co., Inc., 1954. 300 pp.

James, B.D. "The Effect of Weight Reduction on the Physical Condition of High School Wrestlers." Unpublished Master's thesis, State University of Iowa, Iowa City, 1960. 15 pp.

Kenney, H.E. "Problem of Weight Making for Wrestling Meets." Journal of Health and Physical Education and Recreation, I (March 1940), pp. 24-25.

Mayer, Jean. "Exercise and Weight Control." Science and Medicine of Exercise and Sports. New York: Harper, 1960. pp. 301-310.

Mickelson, D. "Dehydration." U.S. Department of Agriculture Yearbook, 1959, p. 168.

Nichols, H.J. "The Effects of Rapid Weight Loss on Selected Physiologic Responses of Wrestlers." Unpublished Doctoral dissertation, University of Michigan, Ann Arbor, 1957. 101 pp.

Schuster, Abraham L. "The Effects of Rapid Weight Reduction on the Endurance and Performance of Wrestlers." Unpublished Master's thesis, Pennsylvania State University, University Park, 1954. 37 pp.

The Skinfold Test. New York: Lederle Laboratories, 1962. 21 pp.

Taylor, H.L. "Performance Capacity and Effects of Calorie Restriction with Hard Physical Work on Young Men." Journal Applied Physiology, 10 (1957), pp. 421-429.

Tuttle, W.W. "The Effect of Weight Loss by Dehydration and the Withholding of Food on the Physiologic Responses of Wrestlers." Research Quarterly, XIV (May 1943), pp. 158-167.

Yoshimuro, Hisato. "A Contribution to the Knowledge of Dehydration of Human Body." Journal of Biochemistry, XL (July, 1953), pp. 361-374.

Young, D.R., Iacovino, A., Erve, P., Mosher, R. and Spector, H. "Effect of Time after Feeding Carbohydrate or Water Supplement on Work in Dogs." Journal of Applied Physiology (1959), 14:1013.

VITA

William Abbas

Candidate for the Degree of

Master of Science

Thesis: IMMEDIATE EFFECTS OF RAPID WEIGHT LOSS UPON SELECTED PHYSIOLOGICAL AND MOTOR RESPONSES OF COLLEGE WRESTLERS.

Major Field: Health, Physical Education, and Recreation

Biographical:

Personal Data: Born in Algona, Iowa, August 8, 1940, the son of Edward and Alice Abbas.

Education: Attended elementary and junior high school in Titonka, Iowa; graduated from Bedford High School, Bedford, Ohio in 1959; received the Bachelor of Science degree from Iowa State University, with a major in Health, Physical Education, and Recreation, in February, 1964.

Professional Experience: Taught elementary physical education in Boone, Iowa for one year. Graduate Assistant and Assistant Wrestling Coach, September 1964 to June 1965 at Oklahoma State University. Member of the American Association for Health, Physical Education, and Recreation.